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## FLAME CONTACT—A NEW DEPARTURE IN WATER HEATING.\*

It is my intention to prove to you on theoretical grounds, and also by experimental demonstration in such a manner as will admit of no possible doubt, that the present accepted system of water heating, by gaseous or other fuel, is a very imperfect means for an end, and is, both in theory and practice, essentially faulty. My statements may appear bold, but I come prepared to prove them in a manner which I think none of you will question, as the matter admits of the simplest demonstration. I will, in the first place, boil a specified quantity of water in a flat-bottomed vessel of copper; the time required to boil this you will be able to take for yourselves, as the result will be visible by the discharge of a strong jet of steam from the boiler. I will then take another copper boiler of the same form, but with only one-half the surface to give up its heat to the water, and will in this vessel boil the same quantity of water with the same burner in a little over one-half the time, thus about doubling the efficiency of the burner, and increasing the effective duty of the heating surface fourfold, by getting almost double the work from one-half the surface.

The subject is a comparatively new one, and my experiments are far from complete on all points, but they are sufficiently so to prove my case fully. As, no doubt, you are all aware, it is not possible to obtain flame contact with any cold, or comparatively cold, surface. This is readily proved by placing a vessel of water with a perfectly flat bottom over an atmospheric gas-burner; if the eye is placed on a level with the bottom of the vessel, a clear space will be seen between it and the flame. I cannot show this space on a lecture table to an audience, but I can prove its existence by pasting a paper label on the bottom of one of the boilers, and exposing this to the direct impact of a powerful burner during the time the water is being boiled, and you will see that it comes out perfectly clean and uncolored. Now, it is well known that paper becomes charred at a temperature of about 400° F., and the fact that my test-paper is not charred proves that it has not been exposed to this temperature, the flame being, in fact, extinguished by the cooling power of the water in the vessel. I need hardly remind you that the speed with which convected or conducted heat is absorbed by any body is in direct ratio to the difference between its own temperature and that of the source of heat in absolute contact with it; and, therefore, as the source of the heat taken up by the vessel is nothing but unburnt gases, at a temperature below 400° F., the rate of absorption cannot, under any circumstances, be great, and the usual practice is to compensate for this inefficiency by an enor-

mous extension of surface in contact with the water, which extension I will prove to you is quite unnecessary. You will see I have here a copper vessel with a number of solid copper rods depending from the lower surface; each rod passes through into the water space and is flattened into a broad head, which gives up its heat rapidly to the water. My theory can be stated in a few words: The lower ends of the rods, not being in close communication with the water, can, and do attain, a temperature sufficiently high to admit of direct flame contact, and as their efficiency, like that of the water surface, depends on the difference between their own temperature and that of the source of heat in absolute contact with them, we must, if my theory is correct, obtain a far greater duty from them. I do not wish you to take anything for granted, and although the surface of the rods, being vertical, can only be calculated for evaporating power at one-half that of a horizontal surface, as is usual in boiler practice, my margin of increased duty is so great that I can afford to ignore this, and to take the whole at what its value would be as horizontal surface, and still obtain a duty 50 per cent. greater from a surface which is the same in area as the flat-bottomed vessel on the fire side, but having only one-third the surface area in contact with the water. I do not, of course, profess to obtain more heat from the fuel than it contains, but simply to utilize that heat to the fullest possible extent by the use of heating surfaces, beyond comparison smaller than what have been considered necessary, and to prove not only that the heating surfaces can be concentrated in a very small area, but also that its efficiency can be greatly increased by preventing close water contact, and so permitting combustion in complete contact with a part of the heating surface. I will now boil 40 ounces of water in this flat-bottomed copper vessel, and, as you will see, sharp boiling begins in 3 minutes 15 seconds from the time the gas is lighted. The small quantity of steam evolved before this time is of no importance, being caused partly by the air driven off from the water and partly from local boiling at the edges of the vessel owing to imperfect circulation. On the bottom of this vessel is pasted a paper label which you will see is untouched by the flame, owing to the fact that no flame can exist in contact with a cold surface.

It may be thought that, owing to the rapid conducting power of copper, the paper cannot get hot enough to char. This is quite a mistake, as I will show you by a very curious experiment. I will hold a small plate of copper in the flame for a few seconds, and will then hold it against the paper. You will see that, although the copper must of necessity be at a temperature not exceeding that of the flame, it readily chars the paper. We can, by a modification of this experiment, measure the depth of the flameless space, as the copper, if placed against the paper before it has time to be previously heated, will, if

\* A Paper read by Thomas Fletcher, F.C.S., at the Gas Institute Meeting, London, June 9th.

not thicker than  $\frac{1}{16}$  inch, never become hot enough to discolor the paper, showing that the flame and source of heat must be below the level of a plate of metal this thickness.

In repeating this experiment I must caution you to use flour paste, not gum, which is liable to swell and force the paper past the limit of the flameless space, and also to allow the paste to dry before applying the flame, as the steam formed by the wet paste is liable also to lift the paper away and force it into the flame. I will now take this vessel, which has only one-half the surface in contact with the water, the lower half being covered with copper rods,  $\frac{1}{16}$  inch diameter,  $\frac{1}{2}$  inch centers apart, and  $1\frac{1}{2}$  inch long, and you will see that, with the same burner as before, under precisely the same conditions, sharp boiling takes place in 1 minute 50 seconds, being only 13 seconds more than half the time required to produce the same result with the same quantity of water as in the previous experiment. Although the water surface in contact with the source of heat is only one-half that of the first vessel, and the burner is the same, we can see the difference not only in the time required to boil the 40 ounces of water, but also in the much greater force and volume of steam evolved when boiling does occur. With reference to the form and proportions of the conducting rods, these can only be obtained by direct experiment in each case for each distinct purpose. The conducting power of a metallic rod is limited, and the higher the temperature of the source of heat, the shorter will the rods need to be, so as to insure the free ends being below a red heat, and so prevent oxidation and wasting. There are also other reasons which limit the proportions of the rods, such as liability to choke with dirt and difficulty of cleaning, and also risk of mechanical injury in such cases as ordinary kettles or pans; all these requirements need to be met by different forms and strengths of rods to insure permanent service, and, as you will see further on, by substituting in some cases a different form and type of heat conductor. To prove my theory as to the greater efficiency of the surface of the rods in contact with the flame, as against that in direct contact with the water, I have another smaller vessel which, including the rods, has the same total surface in contact with the flame, but only one-third the water surface as compared with the first experiment. Using again the same quantity of water and the same burner we get sharp boiling in 2 minutes 10 seconds, being an increase of duty of 50 per cent., with the same surface exposed to the flame. The rods in the last experiment form two-thirds of the total heating surface, and if we take, as I think for some careful experiments we may safely do, one-half the length of the rods to be at a temperature which will admit of direct flame contact, we have here the extraordinary result that flame contact with one-third of the heating surface increases the total fuel duty on a limited area 50 per cent. This really means that the area in contact with flame is something like six times as efficient as the other. In laboratory experiments it is necessary not only to get your result, but to prove your result is correct, and the proof of the theory admits of ready demonstration in your own laboratories, although it is unfit for a lecture experiment, at all events in the only form I have tested it. If you will take two ordinary metal ladles for melting lead, cover the lower part of one

of these with the projecting rods or studs and leave the other plain, you will find on melting a specified quantity of metal in each that the difference in duty between the two is very small. The slight increase may be fully accounted for by the difference in the available heating surface reducing the amount of waste heat passing away, and this proves that flame contact, and, therefore, quick absorption of heat, takes place on plain surfaces as soon as these are above a certain temperature, which, in a metal ladle, very soon occurs. What the temperature is which admits of flame contact I have, as yet, not been able to test thoroughly, and it will need some consideration how the determination of this is to be correctly made; at the same time it is a question in physics which should be capable of being answered.

Let us now take the other side of the question. If the efficiency of a surface depends on flame contact, there must, of course, be flame, or at least gases of an extremely high temperature, and we, therefore, cannot expect this extraordinary increase of efficiency in any part of our boiler except where flame exists, and if these projectors are placed in a boiler, anywhere except in contact with flame, their efficiency must be reduced to that of ordinary heating surface. They are, of course, useful, but only in the same way as ordinary flue surface. When we come to boilers for raising steam, which have to stand high pressures, we come to other difficulties of a very serious nature, which require special provision to overcome them. To put such rods as I have referred to in a boiler-plate necessitates the plate being drilled all over with holes, causing a dangerous source of weakness, as the rods cannot be used as stays; further than this, they would render really efficient examination a matter of extreme difficulty, and would be liable to give rise to frequent and almost incurable leakages; but there is, fortunately, a very simple way to overcome this difficulty. I have found that rods or points, such as I have described, are not necessary, and that the same results can be obtained by webs or angle-ribs rolled in the plates. My experiments in this direction are not complete, and at present they tend to the conclusion that circular webs, which would be of the greatest efficiency in strengthening the flues, are not so efficient for heating as webs running lengthwise with the flue, and in a line with the direction of the flame. This point is one which I am at present engaged in testing with experimental boilers of the Cornish and Lancashire types, and as, with gas, we have a fuel which renders every assistance to the experimenter, it will not take long to prove the comparative results obtained by the two different forms of web. Those of you who have steam boilers will, no doubt, know the great liability to cracking at the rivet-holes in those parts where the plates are double. This cracking, so far as my own limited experience goes, being usually, if not always, on the fire side, where the end of the plate is not in direct contact with the water—where it is, in fact, under the conditions of one of the proposed webs—I think we may safely come to the conclusion that this cracking is caused by the great comparative expansion and contraction of the edge of the plate in contact with the fire; and it will probably be found that if the plates are covered with webs the whole of the surface of the plates will be kept at a higher and more uniform temperature, and the tendency to cracks at

the rivet-holes will be reduced. This is a question not entirely of theory, but needs to be tested in actual practice.

There is another point of importance in boilers of the locomotive class, and those in which a very high temperature is kept in the fire-box, and this is the necessity of determining by direct experiment the speed with which heat can safely be conducted to the water without causing the evolution of steam to be so rapid as to prevent the water remaining in contact with the plates, and also whether the steam will or will not carry mechanically with it so much water as to make it objectionably wet, and cause priming and loss of work by water being carried into the cylinders. I have observed in the open boilers I use that when sufficient heat is applied to evaporate 1 cubic foot of water per hour from 1 square foot of boiler surface, the bulk of the water in the vessel is about doubled, and that the water holds permanently in suspension a bulk of steam equal to itself. I have, as yet, not had sufficient experience to say anything positively as to the formation or adhesion of scale on such surfaces as I refer to, but the whole of my experimental boilers have up to the present remained bright and clean on the water surface, being distinctly cleaner than the boiler used with ordinary flat surfaces. It is, I believe, generally acknowledged that quick heating and rapid circulation prevents to some extent the formation of hard scale, and this is in perfect accord with the results of my experiments. The experiments which I have shown you I think demonstrate beyond all question that the steaming power of boilers in limited spaces, such as our sea-going ships, can be greatly increased; and when we consider how valuable space is on board ship, the matter is one worthy of serious study and experiment. It may be well to mention that some applications of this theory are already patented.

I will now show you as a matter of interest in the application of coal gas as a fuel how quickly a small quantity of water can be boiled by a kettle constructed on the principle I have described, and to make the experiment a practical one I will use a heavy and strongly-made copper kettle which weighs  $6\frac{1}{2}$  pounds, and will hold when full one gallon. In this kettle I will boil a pint of water, and, as you see, rapid boiling takes place in 50 seconds. The same result could be attained in a light and specially made kettle in 30 seconds, but the experiment would not be a fair practical one, as the vessel used would not be fit for hard daily service, and I have, therefore, limited myself to what can be done in actual daily work rather than laboratory results, which, however interesting they may be, would not be a fair example of the apparatus in actual use at present.

#### THE GRAPHOPHONE.

ONE of the most brilliant conceptions of Mr. Thomas A. Edison was, that a record could be made of sounds from which the sounds could be reproduced. After considerable experiment, Mr. Edison invented the instrument known the world over as the phonograph. This little machine consists of a cylinder about three inches in diameter, covered with a shallow spiral groove, upon which is placed tinfoil. The cylinder is so arranged that it will travel horizontally back or forth by means of a

screw, and is operated by a crank. The sounds are communicated to the tinfoil by a steel point attached to a diaphragm that is agitated by the sounds coming through a tube, to which is attached a mouth-piece. The concussion of the sound-waves striking upon the diaphragm forces the metal point forward, which is already in contact with the tinfoil, and makes indentations as the cylinder revolves with the movement of the crank.

In order to reproduce the sounds the diaphragm is replaced to its point of starting, and the steel point goes over the record, following the path of the indentations made on the tinfoil upon the rotation of the cylinder. The point agitates the diaphragm, which in turn agitates the air in the tube, and the repetition of the sound is thereby produced.

Several hundred of the machines above described were put upon the market, and quite a number were sold, but the phonograph failed to make a success, for the reason that the machine was not only a clumsy piece of mechanism, frequently getting out of adjustment, but more especially because of the fact that the surface upon which the record was made was pliable, and likely to be obliterated by a mere accidental pressure upon it.

Believing in the possibility of making a successful machine to record and reproduce sounds, Prof. Alexander Graham Bell, Dr. Chichester A. Bell, and Mr. Sumner Tainter associated themselves together, under the name of the Volta Laboratory Association, and established a laboratory in the city of Washington, one of the principal objects of which was to experiment upon methods of recording and reproducing sound. After several years of experiment the inventors of the graphophone now desire that the writer shall introduce to the world the results they have obtained.

The word "graphophone" is a simple transposition of the word "phonograph," and is intended to convey the same meaning.

Mr. Sumner Tainter soon saw that tinfoil presented a surface unfit for the purpose it was called upon to fulfill, because of its pliability and destructibility. Many and elaborate experiments were made to discover a substance upon which a perfect and durable sound-record could be made. Mr. Tainter conceived the idea of using a surface upon which the sound-record could be cut, instead of indenting a soft and pliable surface as is done in the Edison machine. It was finally decided upon to use a paper surface coated with a preparation composed of wax and paraffine.

The graphophone is made in two forms, one to make the records upon a cylindrical surface, the other upon a disk or flat surface, the same principles, however, governing each machine. The machines are provided with two diaphragms; one used in making the record and the other in reproducing the sound. The cylindrical machine stands about five or six inches high by eight wide, and weighs about ten pounds. There is no skill required in the manipulation of the machine, the rotation of the cylinder being accomplished by a crank or automatic motion. Mr. Tainter has exhibited a great amount of ingenuity and skill in devising the various parts of the machine, and suiting them to the purposes for which they were designed. The instrument is a marvel of perfection in accuracy of the movements of all its parts.

Upon a diaphragm three inches in diameter a steel point is attached, which cuts a minute hair-line in the surface of the waxed cylinder upon the agitation of the diaphragm by a sound. The indentation is so slight as to be scarcely perceptible, and yet these records can be gone over time and again, and are just as perfect after a hundred repetitions as they were at first.

Upon a cylinder six inches in length by an inch and a quarter in diameter, one is enabled to record at least five minutes' conversation. The cylinder-holder is constructed with a ball joint at one end, and can be easily tipped so as to allow the hollow cylinder to be rapidly slipped on or off.

The disk machine possibly has some advantages over the cylindrical machine, because of the fact that the record is made upon a flat surface, and appears in the form of a spiral line. For the purpose of copying records, and possibly for preservation, the flat surface is probably superior, but as each machine has advantages peculiar to itself, it is a difficult matter to judge which will prove the superior for all purposes.

Either of these machines is in a condition at the present time to do the amanuensis work usually done by stenographers. For instance, any one may sit before the graphophone and in ordinary tones speak his daily correspondence into the machine. His letters can then be written by a copyist, who can write from the dictation of the machine.

By a neat mechanical contrivance the operator is enabled to take as many words at a time as he can conveniently remember, and should he forget any part of the sentence, by a slight pressure of the finger on a rod running along the base of the machine the reproducer will repeat the sentence.

Should a correspondent also have a graphophone, the writer of the letter could in a few moments dictate what would make a lengthy epistle, enclose it in a box about the size of the apothecary's "pill box," place a stamp thereon, and transmit through the mails. The correspondent can in turn place the cylinder received upon his graphophone, and listen to the letter of his friend with his voice preserved, thereby avoiding the vexation and loss of time consequent upon an encounter with bad chirography.

One of the most novel and interesting features of this machine is its ability to record the sounds of a number of voices speaking at the same time; this is done on one instrument, by one diaphragm, one metallic point, and upon a single line. How it is done finds an explanation in the fact that the different tones of the voices vibrate with unlike speed and force, and thus make different impressions upon the diaphragm, and move the metallic point in a different way, so as to make a record of the various sounds. The diaphragm of this machine, like the drum of the ear, can receive and record distinctly the various sounds of a quartet of singers.

The graphophone is now prepared to represent all moods; it will tell you a funny story, and laugh with you in natural tones; it will repeat a tragedy that is blood-curdling in its nature; it will tell you a love story with all the ardor of a wooer; it will sing you an Irish song, or whistle a selection from the "Mikado."

It is expected soon to be able to correctly reproduce

the songs of great singers, and the recitations, dialogues, etc., of distinguished actors, and, by a process already successful, to copy the records of the songs or recitations and dispose of them at a trifle, thus enabling a person to enjoy at home such delightful singing as Patti would render, or such elocution as we would listen to from Edwin Booth.—F. Z. MAGUIRE, in *Harper's Weekly*.

#### The Master Mechanics' Association.

COMMITTEES AND SUBJECTS FOR DISCUSSION AT THE TWENTIETH ANNUAL MEETING, JUNE, 1887.

No. 1. *Proportion of Locomotive Cylinders.* To give the best results, what rule should be followed for proportioning the cylinders of an engine, when the size of driving-wheels, weight available for adhesion and boiler steam pressure are given quantities? Charles Blackwell, Union Pacific; F. L. Wanklyn, Grand Trunk; T. E. Barnett, Canadian Pacific.

No. 2. *Traction Increases.* Their various types and relative merits; also, cases in which their use can be recommended. R. H. Briggs, Chesapeake, Ohio & South-western; D. O. Shaver, Pennsylvania; T. J. Hatswell, Flint & Pere Marquette.

No. 3. *Cross-heads and Guide-Bars.* The various types in use, the materials and their construction, and results obtained. F. M. Dean, N. W. Harrison, J. B. Henny, New York & New England.

No. 4. *Packing.* The various forms of piston packing in use, and obtained results. Also, the most economical and satisfactory packing for piston-rods, valve-stems, regulator and air-pump stuffing boxes, with results obtained. J. W. Stokes, Ohio & Mississippi; Allen Cooke, Chicago & Eastern Illinois; Henry Schlacks, Illinois Central.

No. 5. *Locomotive Preparation.* Washing and lighting up locomotives; showing the best system in use for washing out and the most economical and expeditious mode of raising steam and the necessary plant for same. G. W. Ettenger, Chesapeake & Ohio; W. H. Thomas, East Tennessee, Virginia & Georgia; T. W. Gentry, Richmond & Danville.

No. 6. *Coaling up Locomotives.* The various plans in use and their relative cost and efficiency. J. Davis Barnett, Canadian Pacific; James Strode, Northern Central; Charles Graham, Delaware, Lackawanna & Western.

No. 7. *Standard Form of Tire Section.* J. N. Lauder, Old Colony; Jacob Johann, Chicago & Atlantic; H. N. Sprague, Pittsburgh, Pa.

No. 8. *What Control has the Engineer Over the Wear of Driving-Wheel Tire?* John McKenzie, New York, Chicago & St. Louis; J. S. Graham, Lake Shore & Michigan Southern; Fred. B. Griffith, Delaware, Lackawanna & Western.

*Associate Member Papers.*—F. B. Miles, Robert Grimshaw.

#### OBITUARY COMMITTEE.

*M. M. Pendleton.*—C. W. Walker, Seaboard & Roanoke; J. F. Devine, Wilmington & Weldon; James McGlenn, Carolina Central.

*G. E. Boyden.*—J. N. Lauder, Old Colony; George Richards, Boston & Providence; Jos M. Whitlock, New Haven & Derby.

*S. H. Dotterer.*—R. C. Blackall, Delaware & Hudson Canal; H. W. Eddy, Boston & Albany; O. Stewart, Fitchburg.

*J. C. McCune.*—J. S. Turner, Mexican Central; H. P. Olcott, Atchison, Topeka & Santa Fe; A. H. Watts, Texas Pacific.

*John Iranson.*—James Patterson, Cincinnati, Indianapolis, St. Louis & Chicago; E. A. Campbell, East & West Texas; James Meehan, Cincinnati, New Orleans & Texas Pacific.

#### GENERAL SUPERVISORY COMMITTEE.

*Printing and "Boston Fund."*—William Woodcock, Jacob Johann, R. H. Briggs, J. H. Setchel, George Richards.

*Standing Committee on Subjects.*—T. B. Twombly, Chicago, Rock Island & Pacific; Charles Blackwell, Union Pacific; George Hackney, Atchison, Topeka & Santa Fe.

*Committee of Arrangements of Twentieth Annual Meeting.*—Geo. W. Cushing, Northern Pacific, St. Paul; Clem. Hackney, Union Pacific, Omaha; R. R. Bushnell, Burlington, Cedar Rapids & Northern, Cedar Rapids.

#### Inoxidizable Surfaces for Iron.

THERE are many methods, technically known as "bronzing," for rendering the surface of iron inoxidizable, but they are confined to certain trades, such, for instance, as gunmaking, and the engineer knows but little of them. He has neither the time nor the patience to carry out the ten or twenty alternate rustings and polishings which are required to get a good bronzed surface. If he has to expose bright work to the weather, his only resources are constant greasing and rubbing, or the paint brush. In the case where the metal is black, he has a little more scope and can employ either galvanizing or the Bower-Barff process, and cover the object with a protective skin of either zinc or magnetic oxide of iron. A new method, which promises to be easier of application than any of the previous, has, however, been lately brought out by M. A. de Meritens, the well-known electrician, and if it succeeds as well in the hands of the public as it does with the inventor, should find a very extended application. The article to be protected is placed in a bath of ordinary or distilled water, at a temperature of from 70° to 80° Centigrade (158° to 176° Fahr.) and an electric current is sent through. The water is decomposed into its elements, oxygen and hydrogen, and the oxygen is deposited on the metal, while the hydrogen appears at the other pole, which may either be the tank in which the operation is conducted, or a plate of carbon or metal. The current has only sufficient electromotive force to overcome the resistance of the circuit and to decompose the water, for if it be stronger than this, the oxygen combines with the iron to produce a pulverulent oxide which has no adherence. If the conditions are as they should be, it is only a few minutes after the oxygen appears at the metal, before the darkening of the surface shows that the gas has united with the iron to form the magnetic oxide  $\text{Fe O}_4$ , which it is well known will resist the action of the air, and protect the metal beneath it. After the action has continued an hour or two, the coating is sufficiently solid to resist the scratch brush, and it will then take a brilliant polish. The depth of penetration is shown by the following fact.

A gun barrel was oxidized, and then the magnetic coating was completely removed by emery, until the surface again became white. It was again returned to the bath, and immediately, on the passage of the current, the black color again reappeared. If a piece of thickly rusted iron be placed in the bath, its sesquioxide ( $\text{Fe}^2 \text{O}^3$ ) is rapidly transformed into the magnetic oxide. This outer layer has no adhesion, but beneath it there will be found a coating which is actually a part of the metal itself.

In the early experiments with this process, M. de Meritens employed pieces of steel only. But when he turned to objects in wrought and cast-iron he found that he no longer was successful, for the coating was not fast, and came off with the slightest friction. After many trials with currents of different electromotive force, he reversed the order of affairs, and placed the iron at the negative pole of the apparatus, after it had been already applied to the positive pole. Here the oxide was reduced, and hydrogen was accumulated in the pores of the metal. The specimens were then returned to the anode, when it was found that the oxide appeared quite readily and was very solid. But the result was not quite perfect, and it was not until the bath was filled with distilled water, in place of that from the public supply, that a perfectly satisfactory result was attained.

The process, it will be seen, is perfectly simple, and demands but little skill in its execution. Now that dynamo machines have superseded batteries as sources of electricity, all that is required is a tank, a quantity of distilled water, and a little power to drive the machine. By placing a number of baths in series, and increasing or diminishing their number, the electromotive force of the current can be regulated without any arrangements of artificial resistances. We expect that many manufacturers will give this process a trial.—*Engineering.*

#### Railroad Signals.

A CORRESPONDENT in the *English Mechanic* discusses the subject of signals in the following catechetical form:

*Q.* What are railroad signals for?

*A.* To admit a train into a section and to protect it as long as it is in that section by securing an interval of space between it and any following train. Accepting this as their chief function, it goes without saying that good sighting of them is the first essential, and, without wishing to be dogmatical, I claim that this disposes of all argument on the point of which side of the line should they be on. They are for use, and must be where they can best be seen by an approaching driver, and they are not required to be part of a rigid system of propriety, although if, when they are set back a sufficient distance to fulfill their object, they can be as well seen on the left hand or near side of the line as elsewhere, the near side is undoubtedly the right place for them; if not, put them where they can best be sighted. I would not increase the distance simply to get the signal on the near side, having regard to the accompanying disadvantages of increased liability to broken wires, longer lengths of wire for expansion and contraction, more costly to maintain, and a harder pull for the signalman.

*Q.* What should the colors of the signal-lamps be?

*A.* All are agreed as to red for danger, "stop," but some

confusion arises from differences of practice as to the color for "go on." It is necessary that the invitation to a driver to go on should be as unmistakable as the signal to stop. White near a town or highway may be a street-lamp, or it may be a danger signal with the red spectacle broken out. A white light, therefore, when seen by a driver where he expects to find his signal, but fails to do so, should be treated as a danger signal, for it may be his own signal at danger and the spectacle broken, or his signal at danger may be blown out; and, as white will not, therefore, do for the "go on" signal, we are left with green as the only alternative. Thus, we have simplicity itself, and the nearest approach to efficiency with it—namely, red, "stop"; green, "go on." These, I submit, are the only two signal lights a driver should have. The terms "caution" and "all right," as separate from each other, are, I consider, likely to lead to confusion—of sense, at any rate. Caution is always necessary in railway working, and to draw a distinction between a "caution" signal and an "all-right" signal (by a *reductio ad absurdum*—go on without caution) is bad in principle. Of course, my remarks are directed to block working, and leave the old time interval system out of account, and my point is that white as an "all-right" signal should be as obsolete as that time-interval system, of which it formed a part, is becoming.

Q. Should green be used as a back-light?

A. Unhesitatingly, no! The object of a back-light is to let the signalman know, first and foremost, that his lamp is burning, and his signal at danger; and, secondly, that the signal obeys his lever, and as a back-light should not be of such a color that it can be mistaken for a signal, it should not be green. Blue, purple, or yellow are out of the question, and, therefore, we are left with white as the only alternative, and to get the two indications by this means, we must have the white light for the one, and the absence of it for the other, which demonstrates that the right thing for back-lights is white when the signal is at danger; blank—i. e., no light at all—when it is "off." I am fully aware that many companies adopt green as a back-light, some blue; in fact, there is anything but uniformity of practice on this point, and yet it is of great importance, for there can hardly be a railway man of any long experience who has not known of mishap arising from a green back-light being mistaken by a driver for his signal to "go on." To this day, many new signals when put up are provided with green back-lights, which goes to show that the importance of this part of the subject is not fully recognized. For my part, I would rather be without a back-light at all than have a green one.

Another point upon which the views of correspondents would be valuable is, "Should home signals at stations be so locked as to lead the distant signals, or should the distant signal be free to be lowered whether the home signal is at danger or not, and the reasons for and against?"

#### Life and Profits of a Car.\*

WHEN we consider the cost of equipping a road with cars, the expense to keep them in repairs, and mileage earned, we at once have three very important subjects which involve an enormous amount of capital. An in-

\* Read by E. C. Spalding, of the Western & Atlantic Railroad, at the Car Accountants' Convention at Buffalo.

vestigation of the subject cannot fail to be interesting, and we will find some important suggestions presented during our examination. Taking the value of a car as the basis, its mileage as revenue or profit, and the repairs as expense, we are sometimes astonished at the vastness of the interests entrusted to our care. A car will cost \$500. A road owning a thousand will have invested \$500,000; a road operating ten thousand will expend \$5,000,000 in equipping itself, etc. During 1882, our management required me to keep an individual mileage record of each car, and, as we were then in the South interchanging daily reports of movements and mileage, I was able to compile my tables from actual figures, and not estimates. A road, as we before mentioned, secures its cars at an immense expense. These cars are then turned loose upon the country and are expected to earn a reasonable interest on the investment. We see at a glance what an important department in railroads this is. The question then is, what is the revenue and expense involved, and what profit to a railroad is a car? This, of course, depends upon the age and condition of a car. Below I present a table showing the average mileage made by our cars of various ages, also repairs done, thus giving the average revenue, expense, and net loss or profit by cars of various ages:

#### EARNINGS OF BOX-CARS IN GENERAL SERVICE.

Mileage.	Money.	Repairs.	Net Profit.	Percent Profit.	Net Loss.	Per cent. Loss.	Age of car Years.
13,149	\$98.62	\$9.58	\$89.04	18			1
13,478	101.08	38.13	62.95	12½			2
10,475	78.56	48.24	30.32	6			3
9,847	73.85	45.85	28.00	6			4
9,881	74.11	57.31	16.80	3			5
9,349	70.12	70.74			\$0.62	1-9	6
8,968	67.26	60.74	6.52	1¼			7
9,250	69.37	55.49	13.88	2-5			8
9,295	69.71	49.80	19.91	4			9
7,656	57.42	53.67	3.75	¾			10

It will be noticed that, for the first five years cars make good mileage, and will average 9 per cent. profit on the investment; but, during the next five years the mileage decreases, repairs increase, and the net profit is reduced to an average of one and three-fifths per cent. This suggests that for the first five years of a car's life it is a good investment, but after that it is not profitable to run them as an investment. For the first five years a car will net 9 per cent. on the investment, or about half pay for itself in mileage; after that it is almost "nip and tuck" between mileage and repairs for the next five years. The life of a car depends altogether upon how long a road is willing to patch it up with repairs. I believe we have an occasional car now in service which was built twenty years ago, but I apprehend that very little of the original cars remain, and that it has been more expensive to keep them up than it would have been to have destroyed them and used the old iron in the construction of new cars. These figures prove, I think, that mileage at the rate of three-fourths cent per mile is not excessive, and results only in a fair profit on the investment.

#### Comparative Performance of Simple and Compound Locomotives on Von Borries's System.

Engineering of July 16th, contains a tabular statement which gives the results of comparative trials to determine the saving of fuel with compound locomotives, built on the system of Von Borries, compared with "normal" or simple engines. The results of these trials may be summarized as follows:

1. In the winter of 1882-83, runs with two compound goods and two "normal" goods locomotive engines, and with special trains, made soon after the engines were delivered, and before the persons in charge of them had become well acquainted with the compound system, showed a saving by the compound engines of 10.5 per cent. of fuel.

2. In the summer of 1883, runs with a compound goods engine, six wheels coupled, and a "normal" engine of the same type, with goods traffic, showed a saving of 17 per cent. of fuel.

3. In the autumn of 1883, runs with same compound engine that was used in the second trial, and two "normal" goods engines, with six wheels coupled, made with two special trains, only on mountain stretches, showed a saving of 20 per cent. of fuel.

4. From July 1st, 1883, to April 1st, 1884, a comparison of the performance of two compound engines, like those used in previous trials, and ten "normal" goods engines, with six wheels coupled, showed a saving of 21 per cent. The result of saving in this case was arrived at by an average proportion of the actual consumption of fuel, and the quantity usually allowed for each performance.

5. In the summer of 1884, one of the compound engines used in previous trials and ten "normal" goods engines made runs, with goods trains, showed a saving of 14.3 per cent.

6. In the summer of 1884, one of the compound and one of the simple engines, used in previous trials, made runs with special trains and showed a saving of 16 per cent.

7. Another trial under the same conditions as the previous one described, but made in the autumn of 1884, showed a saving of 16 per cent.

8. From October 1st, 1884, to January, 1885, runs were made with a compound "omnibus" tank engine, uncoupled, and a "normal omnibus" tank engine, also uncoupled, with omnibus trains, and showed a saving of 17 per cent. The saving gained was arrived at as in trial No. 4.

9. From November, 1884, to January, 1885, runs were made with one compound express engine, with four wheels coupled, and a "normal" express engine, with four wheels coupled, and with special trains, a passenger and an express train, and showed a saving of 16 per cent.

10. This trial was made with a compound and a "normal" express engine, with three passenger trains, one courier train and two express trains, and showed a saving of 14.5 per cent.

The first trial lasted three months, the second, third, fifth, sixth, seventh, ninth and tenth lasted two months, and the fourth nine months. The steam pressure varied from 9 to 12 atmospheres.

#### Boiler Radiation Tests.

PROFESSOR KENNEDY has recently made some careful tests in the Engineering Laboratory of University College, London, of the radiation of heat from a boiler covered and uncovered. The boiler is described as being of the marine locomotive type with a total heating surface of 205 square feet. The working pressure was 120 pounds per square inch. The external radiating surface of the boiler is about 143 square feet.

The results of these trials with the boiler uncovered, showed that, starting with an average pressure of 110 pounds per square inch, it took nearly six hours to reach atmospheric pressure after the fires were withdrawn. The rate of transmission of heat from the surface was about 750 thermal units per square foot per hour at starting, and was diminished to about 400 after six hours, the rate of diminution being fairly constant.

The boiler was then covered all over with a layer, about  $1\frac{3}{4}$  inch thick, of non-conductor (Keenan's composition), and the experiments repeated under like conditions. After eleven hours there was still a pressure in the boiler of 10 pounds per square inch above the atmosphere. The maximum rate of transmission of heat from the surface of the boiler, was 330 thermal units per square foot per hour, as against 750 in the previous experiments, and was 210 after eleven hours.

These experiments show clearly the importance of boiler covering, and also give a means of determining its value and the economy resulting from its use. A full report of the experiments is published in *Engineering* of July 30th

#### Automatic Couplings in England.

AT a meeting of the Amalgamated Society of Railway Servants recently held in the offices of the Society in London, the general secretary, Mr. E. Harford, in his report submitted to the meeting, first referred to the fact that he had addressed all the railway companies urging upon them the necessity of adopting on their systems one or the other of the wagon couplings approved by the jurors of the coupling trials which took place at Nine Elms, on March 29th and two following days, by the use of which the dangers attendant upon the men having to pass between, or over, or under buffers of wagons for the purpose of coupling or uncoupling them, can be altogether obviated. As some of the companies took no notice whatever of this appeal. Several others wrote that the matter was under consideration. The executive committee passed the following resolution on the coupling question: "That the committee regrets—and considers that the public will regret—that after the trials at Nine Elms proved beyond doubt that efficient mechanical couplings had been invented and were ready to be employed, the railway companies of the country are still neglecting to provide for the safety of the lives of their servants, by adopting one or the other of the appliances of which we so highly approve, as we know by experience that they will greatly reduce, if not entirely prevent, the fearful loss of life which is so terrible; and we are also of opinion that the neglect of the companies should receive the attention of the public, the Board of Trade and Parliament."

#### The Electrical Transmission of Force.

DURING the last ten years M. Marcel Deprez has been engaged in experiments connected with the transmission of force by means of electricity. The Rothschilds some time since provided him with an unlimited credit to prosecute his researches at Creil, under the inspection of a commission of thirty-eight men of science. On Friday the commission met to hear a report on the results at present obtained, drawn up at their request by M. Maurice

Lévy. This report was unanimously approved. It appears from it that we can now, with only one generator and only one receptor, transport to a distance of about thirty-five miles a force capable of being used for industrial purposes of fifty-two horse power, with a yield of 45 per cent., without exceeding a current of ten ampères. When the amount of force absorbed by the apparatus used to facilitate the recent experiment, but not required in the applications to industrial purposes, is added, the yield will be nearly 50 per cent.

The commission certifies that the machines now work regularly and continuously. The maximum electro-motive force is 6,290 volts. Before the construction of the Marcel Deprez apparatus the maximum force did not exceed 2,000 volts. The report states that this high tension does not give rise to any danger, and that no accident has occurred during the past six months. The commission is of opinion that the transmitting wire may be left uncovered on poles, provided it be placed beyond the reach of the hand. It estimates at nearly £5,000 the probable cost of the transmission of fifty horse power round a circular line of about seventy miles. This price would, however, be much diminished if the machines were frequently constructed.

The commission, in the name of science and industry, warmly congratulated M. Deprez on the admirable results which he had obtained, and expressed thanks to the Rothschilds for the generous aid extended to the undertaking. —*Correspondence London Times, Paris, July 25th.*

#### Store Orders.

THE Philadelphia Times says: "We print in to-day's paper, in *fac-simile*, variously denominated store orders issued for labor by the 'Bellefonte Iron and Nail Company, Limited,' and with them the full text of the act of 1881 forbidding the use of any form of trade orders for labor, and declaring the penalty for the misdemeanor defined by the law. Special importance will be attached to the trade orders for labor issued by the Bellefonte association, because Gen. Beaver, an honored soldier, respected citizen, and the nominated candidate of the dominant party of the State for Governor, is the chief stockholder and president of the company that thus openly violates the law for the protection of wage-laborers. It will be difficult for Gen. Beaver to exonerate himself from the imputation of deliberate lawlessness, and apparently for the purpose of enlarging the profits of his company at the cost of the labor he employs."

[The above shows that workingmen sometimes have just grounds for complaint and dissatisfaction, a fact which some persons, especially some editors of newspapers, try to induce the public to doubt.—EDITOR RAILROAD JOURNAL.]

#### Slack in Freight Trains.

THE importance which the "slack" of freight trains coupled with the ordinary link and pin was found at the Burlington brake tests to possess, as an element in the production of those severe shocks or bumps experienced in the quick stopping of long trains, led to some very interesting experiments during the last days of the tests. A train of fifty loaded cars was given a continuous close

coupling by driving iron wedges into the links, thus taking up all the loose slack and leaving only "spring" slack, or that which is given by the compression of the draw-bar springs when the train is started. It was found necessary to drop one car before the locomotive could start the train on a level. Without the wedges—that is with about 3 inches of loose slack at each coupling—the same locomotive was able to start but 48 cars. The experiments were repeated on the grade, where the highest number of cars which the engine could start either with close or open couplings was 38. For the first time since the question of the part borne by slack in enabling a locomotive to start a long and heavy train began to be discussed by the inventors of link couplers on one side and of hook couplers on the other, the thing has been put to actual test on the track. It seems to be demonstrated that loose slack gives at least no aid in starting a train, but that the slack given by the buffer springs is sufficient. This result is pleasing to those interested in hook couplers.—*Railway Review.*

#### Tunnel Between Denmark and Sweden.

A TELEGRAM from Copenhagen, published in the *Journal des Débats*, says that the Swedish and Danish newspapers have for some time been discussing schemes for the construction of a tunnel between Denmark and Sweden under the sound. The question of a submarine way between the two countries has been raised several times, but never so seriously as now. In fact, M. A. de Rothe, the engineer, in the name of a French company, has just presented to the two governments interested a plan for cutting a tunnel between Copenhagen and Malmö, in Sweden. The tunnel would be seven and a half miles long, in two parts, of which two miles would lie between the islands of Amak and Sattholm, and five and a half between the latter island and the Swedish coast. M. de Rothe has been for several years employed as an engineer on the Panama Canal works.

#### The Endurance of Paints.

EXPERIMENTS made under the direction of the administration of the Dutch State railroads with various paints on iron plates are reported to have proved that the red-lead paints resist atmospheric influences much better than those of brown-red and iron oxides. The red-lead paints adhered closer to the metal, and possessed greater elasticity than the others. It was also found that better results were attained if, before the paints were applied, the plates were pickled instead of being merely scraped and brushed. The test plates were pickled in muriatic acid, washed with water, thoroughly dried, and while warm, carefully oiled.

#### Uniform Rules for Running Trains.

A MEETING was held in Cleveland on July 20th, the object of which was to devise uniform rules for the movement of trains, to be applied to all the railroads of the country. The parties who held the meeting composed a committee of representatives of a number of prominent railroads. Mr. N. F. Allen, editor of the *Official Railway Guide*, acted as secretary of the committee.

## NOTES AND NEWS.

**RAILS 144 FEET LONG.**—The Tredegar Steel Works, in Wales, are now turning out rails 144 feet in length, and these are cut into six lengths of 24 feet each.

**RAILROAD WORK IN GERMANY.**—The railway wagon and machines works in Germany are all said to be much in want of orders, and none can work full time.

**THE SCHENECTADY LOCOMOTIVE WORKS** now has at work 950 men. From 16 to 18 engines are turned out every month. The monthly pay roll amounts to nearly \$40,000.

**STEEL SLEEPERS.**—The Midland Railway, of England, are extending the experimental use of steel sleepers on their line, and another length of a mile or so in extent is about to be put in between Derby and Duffield.

**RAILS FOR CHINA.**—It is said that the Messrs. Krupp have secured a contract from the Chinese Government for the supply of 1,500 tons of steel rails, the price, including freight, being 25s. per ton below the lowest English offer.

**MINERAL PAINT.**—A deposit of mineral paint at Clifton, Tenn., is thought to be the largest in the world. It is said to be oily, of a venetian red color, and that it is better for iron or tin roofs than lead, as it sticks better. It is believed that several million tons can be mined at a cost of 50 cents per ton.

**STEEL SLEEPER.**—The steel sleeper in England, or steel cross-tie, as it would be called here, has brought a steel chair to the front, by Mr. Thomas, C. E., Brecon & Merthyr Railway. Its merit is extreme simplicity. Railway men of eminence—a correspondent of *The Engineer* says—speak highly of it; and, as steel sleepers are certain to become general, it comes to the front in the nick of time.

**THE LITTLE MIAMI RAILROAD** shops at Cincinnati are to be moved. The whole plant will be taken to Columbus, where a huge establishment is now being fitted up, and where all important repairs will be made, and all building done for the entire Pittsburgh, Cincinnati & St. Louis system. The railroad company bought a large amount of real estate in Columbus a number of years ago for a small sum, and will have the finest and most commodious railroad shops owned by any western road.—*Indianapolis Journal*.

**STEEL SAW.**—The firm of Wilhelm, Hartmann & Co., Fulda, Hesse, has introduced a new steel saw for cutting metals, the teeth of which are as hard as diamonds, whilst the blade remains as flexible as if of unhardened steel. It is reported favorably upon by the metal workers of Remscheid—the Birmingham of Germany. It not only cuts cast and wrought-iron and steel, but glass, and, as is claimed for it, keeps its edge infinitely longer than the very best saws ever yet produced. The firm is now turning its attention to making band saws for cutting out articles in iron, steel, etc.

**PRICE OF LOCOMOTIVES IN EUROPE.**—The lowest tender for the goods engines for the Italian Mediterranean Railway Company has just been accorded to the Austrian-Hungarian State Railway Company, at the price of 96½ cs. per kilo. (about 8½ cents per pound.) To show how prices have declined of late, it may be stated that two years ago a Vienna firm received for some locomotives, delivered to France, 1 f. 69 c. per kilo. (about 14¾ cents per pound), at which price a loss resulted, although, as will be the case now, a drawback of duty was allowed on all foreign materials consumed in their construction.

**SINGULAR RAILROAD INCIDENT.**—A probably unique but melancholy incident occurred in connection with the terrible smash which recently took place near Würzburg on the Bavarian Railway, when two express trains ran full tilt into each other, namely: a guard, who had been on the line twenty-two years, on passing over it the following day, was so affected at the sight of the immense heap of wreckage, that on arriving two hours later at his destination he was seized with a "stroke," which necessitated his conveyance to the hospital, where he now lies in

a precarious state, and will very likely not recover.—*The Engineer*.

**PERMANENT WAY IN ENGLAND.**—At the summer meeting of the Institute of Permanent Way Inspectors, held at Birmingham, recently, the President, Mr. W. C. Keeling, C. E., after speaking of the forms of permanent way in existence in different parts of the country, mentioned that the home railways were now nearly 19,000 miles in length. The rails, originally about 40 pounds per yard, were now nearly 90 pounds per yard, but the increase was due to the locomotive engines employed, which at first were very light, but now, with tenders, weighed 60 to 70 tons. The best kind of permanent way was that which, while being of sufficient strength, possessed the greatest degree of elasticity.

**SKIDDING WHEELS.**—In a paper read at the same meeting, "Upon the Wear of Wheels and Rails by the Action of Skidding Wheels," Mr. W. C. Meredith stated that the adoption of continuous brakes had already been found to have effected considerable economy in the wear of wheels and rails, and other parts of the permanent way; and, he was inclined to think, a not inconsiderable economy in the wear of wheels and rolling-stock generally.

**THE MANCHESTER SHIP-CANAL.**—The promoters of this work have failed in raising the required capital for carrying out this scheme. A subscription was put forward by the Messrs. Rothschild, but the public did not respond. The *Engineer's* correspondent says, "the check given by the temporary failure to find the £8,000,000 required for its construction is not regarded as likely to stop the ultimate result. Orders placed for tools and special machinery for the undertaking are being proceeded with all the same. Manchester has made up her mind that, if she cannot get the sea to her, she will go to the sea; and the battle has gone too far for the victors to be balked on the point of reaping the reward of their labors."

**PERMISSIVE BLOCK SIGNALS.**—In concluding a report on the collision that occurred on the 5th of June at Edgeley Junction, which is about 700 yards at the southeast side of Stockport station, on the London & Northwestern Railway, Colonel F. H. Rich says: "The system of permissive block working, which allows two trains to be in the same block section, or to approach a junction at the same time, is dangerous. I consider that the margin of safety between the signal when a train should be detained until the junction or block section is clear and the fouling point should not be less than about 400 instead of 42 yards, as in the present case, and a much greater margin of safety should be provided when the trains are not fitted with good continuous automatic brakes."

**THE INDIAN RAILWAY SYSTEM.**—Some idea of the value and importance of the Indian railway system with its connected steamer services, may be gathered from the fact that the capital sunk in these undertakings is estimated at £161,917,840. Of this large sum the government has spent directly £82,255,391. The capital outlay of guaranteed companies stands at £71,032,838, and that of the "assisted" companies at £3,808,232. Native States—the principal in this respect being Mysore and Hyderabad—are responsible for an outlay of £4,821,379 on lines within their territories. When the construction of railways in India was first mooted, there were some who warned the projectors that caste prejudices would prevent the natives from using them; but it is an astonishing fact that last year Indian railways carried no fewer than 80,864,779 passengers, who paid for their fares £5,538,126. In 1884, the number of passengers was 73,815,119, and their freight was valued at £5,070,754. The chief income of most railways, however, is derived from their goods traffic, and in this respect the Indian lines yield more than double the receipts obtained from passengers. No less than 18,925,385 tons of goods were carried, the receipts from which amounted to £11,915,375. Both the tonnage transported and the return show an increase over the figures of the previous year, which was credited with a goods traffic of 16,663,007 tons, and receipts therefrom amounting to £10,565,941.—*London Times*.

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## BOILER EFFICIENCY.

THE paper on "Flame Contact—a new Departure in Water Heating," which is published with this number of the RAILROAD JOURNAL, contains suggestions, with reference to the improvement of boilers, which promise some very important results. The author shows that the temperature of flame, in contact with one side of a plate which is covered with water on the other, is comparatively low; for the reason that the heat of combustion is communicated to the plate as fast as it is produced. From this it follows that the plate itself can never be very hot, and, inasmuch, as the conduction of the heat of the fire, on one side of the plate, to the water on the other will be in proportion to the *difference* in temperature on the two sides, it is obvious that the *rate* at which heat is communicated from the fire to the water will under such conditions be comparatively low. To overcome this difficulty Mr. FLETCHER, the author of the paper referred to, constructed "a copper vessel with a number of solid copper rods depending from the lower surface; each rod passed through into the water space and was flattened into a broad head, which gives up its heat rapidly to the water." The theory being that "the lower ends of the rods, not being in close communication with the water, can, and do attain, a temperature sufficiently high to admit of direct flame contact, and as their efficiency, like that of the water surface, depends on the difference between their own temperature and that of the source of heat in absolute contact with them, we must, if the theory is correct, obtain a far greater duty from them."

There seems to be a little flaw here, in the theory, because no account is taken of the fact that although the rate of conduction of heat is proportional to the difference in temperature, yet it is inversely proportional to the thickness of the plate, or the length of the rod by which it is conducted. It may be true that the lower ends of the copper rods, which the author has described, are heated to a much higher temperature than the plates, but it does not seem certain, as the author appears to assume, that they communicate heat to the water more rapidly than the bottom of his experimental boiler. It seems probable that there is more perfect combustion when the flame comes in contact with the highly heated rods, than results when it impinges against the cold surface of the plate, and that the cause for the difference in the efficiency of the two experimental boilers was due largely to the fact that more heat was developed by the gas burner in one case than in the other. It is true, of course, that some device similar to that which Mr. FLETCHER has experimented with would permit of a very large increase of heating surface in a boiler of a given size, and that in that way it may be possible to much more than compensate

for the retarding effect of the greater distance through which the heat must be conducted by the rods.

There can be no doubt, though, that it is desirable to prevent flame contact with cold surfaces, in order to produce perfect combustion, and that the two functions of combustion and the communication of heat to the water in a boiler should be carried on separately. During the process of combustion the temperature of the fire should be maintained as high as possible, and no heat should be taken from it until *after* the process of combustion is completed. When this is accomplished then the products of combustion may, without loss of economy, come in contact with cold surfaces.

It would follow then, from this reasoning, that it is desirable to extract as little heat as possible from the fire *in the fire-box*, and that we should aim to retain the heat there instead of conveying it to the surrounding heating surfaces, and that a large fire-box would be more economical than a small one, for the reason that the heating surfaces bear a smaller proportion to its grate area than they do in a small fire-box. When large fire-boxes have been used, however, the mistake has often been made of disregarding the importance of maintaining a fire of a high temperature. Slowness, it was thought, was more economical than intensity of combustion. The result was that very large grates were used, which admitted so much cold air that it was impossible to maintain a very hot fire. On the other hand, dead plates in the front, back and sides of fire-boxes have nearly always been found to be economical. There can be no doubt that their effect is to concentrate the draft, in a comparatively small area of the grate, and that it then acts somewhat as the blast does in a blacksmith's fire. The dead-plates also serve the purpose of keeping the flame and gases away from the cold heating surfaces on the sides and end of the fire-box, and they thus help to maintain a high temperature. It would, in fact, seem to be desirable to prevent the communication of heat from the fire until after the products of combustion *have left* the fire-box, and experiments which have been made with fire-boxes lined with fire-brick have shown economical results. Some years ago an engineer on one of the Hungarian State railroads, experimented with a locomotive boiler, which was constructed without water spaces around the fire-box, the latter consisting of a simple sheet-iron shell, lined with fire-brick. He showed very good results therefrom, but experienced some difficulty in keeping the tubes tight, owing to the high temperature of the fire. Some boilers were also built, a few years ago, with fire-boxes of this kind and were put in service on one of the lines of steamboats running from New York, and with very favorable results. For some reason, or perhaps without any reason, this method of constructing fire-boxes for locomotives has been condemned by nearly all

locomotive engineers, without trial. There are certainly some very strong theoretical reasons to recommend it. Whether what appear to be the minor difficulties, which were encountered in the trials made by Mr. VARDEREBER on the Hungarian State railroads, can be overcome, only further experiments can decide. The promise of success is surely sufficient to justify further investigation in this direction.

#### COMPOUND LOCOMOTIVES.

RAILROAD managers should be interested in the account of the relative performance of simple and compound locomotives, an abstract of which is published on another page, and which shows an average saving of over 16 per cent. from the use of that kind of engines. Any one who has had experience in making experiments of this kind will, however, be very cautious about accepting the results, unless the circumstances under which the tests were made are known. Much depends upon the conditions under which the engines are worked, and the care which is taken to produce good results. A careful engineer and fireman can always save fuel with any locomotive, and if it becomes known on a railroad that those in authority are interested in having some engines do well, in comparison with others, the whole corps of employes will favor the favored engines, even if those in authority are disposed to be impartial. Therefore, experiments with locomotives on railroads when the officers are not interested in the improvement experimented with, have very much greater value usually, than they would have if made under the supervision of the author or inventor of the improvement experimented with.

Nevertheless, the tests of the performance of the compound engines referred to, seem to have been made very carefully, and supply strong *prima facie* evidence in favor of the economy of the compound system. As other testimony to that effect has been supplied from other sources, it would seem to be worth while for some of our American railroads to test the compound system. So much has been written (of which a considerable part is the product of ignorance and prejudice) concerning the relative merits of European and American locomotives, that it would seem worth while for some railroad in this country to make a trial of the compound system on a European-built locomotive. This could be done by simply ordering one from some European builder. Any of them would furnish an engine with a truck, and such other features as are here considered essential. The cost of such an experiment would not be very great and the risk very slight, because, in any event, the engine would do effective service or could be altered into a simple engine if it was not more economical than those now in use here.

## EDITORIAL NOTES.

THAT railroad traveling is now safer than it was only a few years ago, was shown at a recent meeting of the shareholders of the Northeastern (of England) Railway. The chairman then reported that in 1870 "the compensation for damages," that is, for personal injuries to passengers, amounted to close on to £60,000. During the past six years the average amount paid was only £15,300 a year, and, for the half-year just ended, the sum paid was only £2,356. The chairman explained that this result was due to the institution of the block system, and also to "the great command over the speed and motion of their trains by the very liberal use of the Westinghouse brake."

M. TOMMASI, the French electrician, proposes to keep the foot-warmers used in European railway carriages up to a certain temperature by means of the heat due to an electric current traversing a high resistance. The current employed to maintain their heat is to be supplied by a dynamo driven off an axle of the train, and the circuit passes through the warmers. A simple device allows of the foot-warmer being thrown out of circuit should it become too hot.

IT is very much to be regretted that some competent person does not undertake to write, or at least to collect the material to write, a history of American railroads. There are still left a very few persons who were identified with the beginning of railroads in this country, but their number is lessened each year. There is also much valuable material destroyed, whenever one of the homes of the old veterans is broken up. Much is still left that can be saved, but a great deal has already been irrecoverably lost.

*The Brotherhood of Engineers' Journal* "conjectures" that there are 9,000,000 of workingmen in the country, and that only a third, or 3,000,000 of them, are members of labor organizations, and its editor "has no hesitancy in saying" that those who hold aloof are openly or covertly the enemies of labor organizations.

*Art of Making Molds in Sand by Machinery for Castings in Iron or Brass.* Peerless Manufacturing Company, Louisville, Ky.

This is a pamphlet printed in a most luxurious style, and contains a description and illustrations of the machines mentioned in the title. The engravings are admirably done, and all the mechanical work is of the very best. The description of the machine is, however, not easy to understand, as there is an entire absence of letters of reference in the description and engravings, so that it is impossible for the reader to tell what parts are referred to, and the description is not at all lucid. It is very much to be regretted that a catalogue which in other respects is so good should be lacking in the one essential of not being easily understood.

## Street-Railways.

## American Street-Railway Association.

*President.*—Julius S. Walsh, President Citizens' Railway Company, St. Louis, Mo.

*First Vice-President.*—William White, President Dry Dock, East Broadway and Battery Railroad Company, New York City.

*Second Vice-President.*—C. B. Holmes, President Chicago City Railway Company, Chicago, Ill.

*Third Vice-President.*—Samuel Little, Treasurer Highland Street-Railway Company, Boston, Mass.

*Secretary and Treasurer.*—William J. Richardson, Secretary Atlantic Avenue Railroad Company, Brooklyn, N. Y.

Office of the Association, cor. Atlantic and Third Avenues, Brooklyn, N. Y. The Fifth Annual Convention of the Association will meet in Cincinnati, O., on Wednesday, October 20th, 1886.

## REASONABLE HOURS OF SERVICE FOR STREET-RAILROAD EMPLOYEES.

THE last annual report of the American Street-Railway Association contains a report of a committee on "Rules Governing Conductors and Drivers," and also a verbatim report of an informal discussion on street-railroad management, the reading of which leaves the impression that, while the lot of a street-railroad employé may be happy, it certainly is not an easy one. The report of the committee begins with the very general statement of the importance that good men should be selected and good rules adopted for their guidance. This is followed by a presentation of rules on "Discipline and Deportment," on "Comfort, Convenience and Safety of the Public," and on the "Collection of Fares," all of which indicate that the qualifications which are expected of such employés imply a very respectable degree of intelligence, and a character considerably above the average of human nature.

In the latter part of the report the committee says that drivers and conductors should be not only faithful but intelligent, and it is recommended that they be selected from among the residents of the city or town in which the road is located, and that *the pay should be sufficient to attract and hold such men, and their hours should be fixed within the bounds of reason.* All our readers will probably agree, that the committee's report would have had much greater interest and probably much more value, if they had defined what hours or daily period of service would be "within the bounds of reason." That is the rock against which conflicting opinions are perpetually striking, and it is owing to the fact that the views of those who are represented in the association referred to, and those employed by them are so irreconcilable, that there is so little peace between the two classes. If the advantages of our much boasted modern improvements are equitably distributed, it seems perfectly reasonable that workingmen to-day should work fewer hours than they did twenty-five or fifty years ago. Human labor has been made many

fold more productive by the discoveries, inventions and organization of modern times. That workmen should demand that their burdens be lightened, is quite natural and reasonable.

Later in the meeting, the report of which has been referred to, the President of the association requested members to suggest subjects for reports and for discussion at the next meeting. If an intelligent and impartial committee of that association should make a full report on the question, "What hours of labor are within the bounds of reason?" it certainly would excite a great deal of interest, and if the officers of the different street-railroads in the country, who are represented in that association, should then discuss the report freely, fully and honestly, giving the true reasons why any given number of hours of service are essential to the welfare of street-railroad companies, it would be a very valuable contribution to the existing knowledge of that very much disputed subject. If those who would take part in such a discussion were frankly to admit the true principle by which they are governed in this matter, it is probable that it would be the same as that adopted by some managers of other railroads, which is to charge all "that the traffic will bear." There can be little doubt that in many cases somewhat the same principle has been applied to the men employed not only on street-railroads, but in many other places. It is the law of supply and demand, without any element of humanity added. Of course, there may be other reasons which control, and, perhaps, should control, the hours of service of employes, and which decide what is reasonable and what is not. No persons are so well able to present these reasons as the members of the American Street-Railway Association. By all means, then, let us have a report and discussion on the question—"What are reasonable hours of service on street-railroads?"

THE Sixth Avenue elevated road will soon be the only representative of the 10-cent tariff. The Third Avenue has reduced the fare on its line, and the vast population dwelling contiguous to its road will be able to ride from Battery to Harlem for 5 cents at any hour. What other city transportation can show a similar record?

\* \* \*

It is a curious fact, that wherever a street-railway had any business worth speaking of, and the proposition was made to reduce the fares, a wail of agony and dissent was sure to be raised by the managers and stockholders. Equally certain was it that when, with great reluctance the reduction was allowed, there has seldom been a desire on the part of the company for a restoration of the former high rates.

\* \* \*

If, as has been suggested, the cut in the fares on the

elevated roads should be met on the part of the surface roads by a reduction to 3 cents, New York would stand at the head of cheap and rapid transit. Even now, no city is her equal, and if the Arcade Railway becomes a reality, she will be beyond the reach of rivalry.

#### The Philadelphia Cable Roads.

THE *New York Times* publishes the following account of the working of the cable lines in Philadelphia:

The Traction Company has now been operating its cable motor long enough to have overcome the difficulties which surrounded its first introduction, and to have made a thorough test of the system on its merits. If successful, its lines ought to be running smoothly, without interruption, and its stock ought to have shown a continued and continuous rise in market value. Its plant ought to be in permanently good order, and its ordinary operation free from accidents which cause expense to the company and vexatious delays to the public. None of these conditions, however, have been fulfilled. Every one who uses the cable road knows that he may be carried to his destination quickly or that he may be subjected to a delay of uncertain length on account of the stoppage of the cable. A well-known wool merchant said of this: "I take a train at the Broad street station for my home late every afternoon. If I take a cable car up Market street, I may catch the train or I may not. Sometimes, when I have grown weary of waiting for the cable car that comes not, I have to walk over to Arch street and ride up that way. Sometimes, when I get started, the car suddenly stops half way, and I have to get out and walk."

It has been said that the Traction Company had been put to enormous and unexpected expense by reason of mistakes made in building their conduits—mistakes that even the extensive and costly repairs of last spring failed to retrieve. The entire conduit, it is said, has proved itself only a temporary structure, and its permanence can only be assured by rebuilding it with solid masonry. Other causes of depression were reports that the cables were constantly wearing out, and that six successive new ones had been secretly laid at night within a comparatively short time, and the suits brought against the Traction Company for the infringement of patents owned by the National Cable Railway Company and the inventor, Henry Root.

The *Times's* correspondent recently visited the engine house of the Market street line, at Twentieth and Market streets, accompanied by one of the officers of the Traction Company, and made a thorough examination of the machinery. No person except the officers and employes of the company is ever allowed to enter the engine house, whose secrets are rigidly guarded from the public. The secrets are interesting, and the heart of the cable system affords material for both entertainment and instruction. There are in the middle of the ground floor two great Corliss engines, each of 300-horse power, running at exactly the same rate of speed. The twin engines are beautiful results of the machinists' work, shining with brass and nickel trimmings and working with an oscillating movement. From their shafts rotary motion is given to two cog-wheels, which transmit the power to two larger

wheels mounted on shafting, which turn the gear wheels of the cables. These larger wheels are of different sizes. One propels the cable running east from Twentieth street to the river at the rate of 7.2 miles an hour, and the other runs the cable running west to the station in West Philadelphia at the rate of 9.1 miles. The eastern engine runs the western cable, and vice versa, the cables crossing under the street in front of the engine house. This arrangement reduces the distance which a car must run by its own impetus after releasing its grip from one cable and before its grip catches the other. When the cables leave the wheels, around which they are wound in grooves several times to prevent their slipping, of course they are at right angles to the street. They run at a downward angle, passing on their way two receptacles which drop upon them tar and boiled linseed oil. After this baptism, at a still lower level, they each reach a large iron wheel with a single groove, around which they are carried until they leave the vault of the engine house far beneath the street and parallel to its course. They rise upward until they rest upon the carrying pulleys of the conduit, along which they travel on their long journey to the termini of the road and back again.

It was difficult to obtain at the engine house any exact figures concerning weights, measurements, consumption of fuel, or number of cars used. The employes, even in the presence of the officer of the Traction Company, talked very guardedly. The company's officer himself, however, volunteered a little information, as he stood looking at the cable that wound endlessly in and out of the building. "That cable," he said, "weighs 38 tons. It is made of the best crucible steel and costs 28 cents a foot. Its tension on these wheels, that is to say, the amount of resistance that must be overcome to move it, is 6,500 pounds. The cables were at first made for the company by the Roeblings at Trenton, but they are now made by the Hazard Manufacturing Company, of Wilkesbarre."

"Do they break often?"

"Well, it isn't so much their breaking that troubles us as their wearing out. You see, it is almost impossible to make so long a cable that is of exactly the same diameter throughout, and that is exactly round. Then, too, the grips, pressing on it here and there at irregular intervals affect its diameter. The curves the cable travels around help to wear it out. Before long a strand breaks, and then I'll show you what happens."

The officer led the way into the vault beneath the street, where the cable entered the engine house, and showed the apparatus for detecting a broken strand. The cable, after entering and before reaching the wheels turned by the engine, passes through a hole in a suspended iron bar. The hole is big enough for the cable to pass without striking, but as soon as the projecting end of a broken strand comes along, it strikes the bar and rings a bell. Then the engines are stopped, all the cars on Market street stand still and several hundred passengers fume at the delay, and a man in the engine house goes to work to remedy the trouble. This is done by cutting off the ends of the broken strand and tucking them snugly into the inside of the rope. This process occupies about 15 minutes; sometimes more, sometimes less.

"Suppose," was suggested, "a strand to be broken on a distant part of the cable, and that it ran through the grip of a car before reaching the engine house?"

"Oh, that often happens, and it causes us no end of trouble. When it does occur, the grip catches the strand, which coils around and around the grip, holding it tight and damaging a great many feet of the cable."

"What most frequently causes the cable to break?"

"Sometimes it breaks because it is worn out. Most frequently, however, such an accident is caused by a careless gripman's failure to release his grip when he comes to a

vault. 'A vault' is a place where the cable takes a sudden dip downward, being carried by pulleys below the reach of the grip, in order to cross another cable, or, as here in front of the engine house, where one cable ends and is carried down to be brought into the engine house. If the grip is kept tight at such a place, it is carried on until it strikes the point where the cable is carried downward. Then something has to give way. The cable can't be pulled up, because it is connected to a 300-horse power engine. The car can't very well be pulled down through the sidewalk. So, to solve the difficulty, the cable breaks."

"And what happens then?"

"Well, if the break is near the engine house, the loose end of the cable comes flying in here and thrashes round and round those wheels. If it should strike any one, good-bye, John! The engines are stopped as quickly as possible, and then the men set to work to splice the ends. That takes a long time, and sometimes as much as 60 feet of cable are used up in the operation."

"How long does it take to put in a new cable?"

"Oh, we can tie the end of a new cable on an old one and pull it through by the engines in a few hours. We usually do that at night. When a new cable is laid for the first time, as was recently done in the Seventh and Ninth streets line, two or three nights are needed, as it has to be dragged through by horses."

"How many new cables have been put into the Market street conduits this year?"

"Four, I think; but I won't be sure. However, when a cable is used up it is not, in one sense, the Traction Company's loss. The Traction Company has a contract with the Hazard Company, which agrees to furnish the cable for so much a month."

"But does not the Hazard Company ask a good round price for such a contract?"

"Yes, it does charge a good deal. If it could make a cable last eight months, it would receive twice as much money as the price of a new cable outright."

## STREET-RAILWAY NEWS.

### ALABAMA.

THE Milner Springs and Birmingham Street-Railway Company has been incorporated at Birmingham by E. Eastman, John Milner and others. Capital stock, \$25,000.

### ARKANSAS.

The Pine Bluff Street-Railway Company has commenced track-laying, and will have several miles of streets traversed by September.

### COLORADO.

The electric railroad on Fifteenth street, Denver, is working satisfactorily. The car runs at about the speed of an ordinary horse-car, but the motion is steadier, and the stopping and starting can be performed in less time. The cars can attain a speed of fifteen miles per hour, and they will be run at this rate on the suburban lines where it is proposed to utilize them. It is claimed that the cost is only a fourth of that for operating with horses.

### CONNECTICUT.

All the stock of the Meriden Horse-Railroad Company has now been subscribed for and work will be started at once.

### ILLINOIS.

The Chicago Elevated Railway Company has been incorporated to build a line from Thirty-ninth street on the South side, to Lake View on the North side. John Tomlinson, James Bryant and A. C. Knapp, of Chicago, are the incorporators.

The Chicago Passenger Railway Company will experiment with a cable system.

At Springfield the Belt Railway Company has been organized by F. W. Tracy, with a capital stock of \$10,000.

## KANSAS.

A horse-railway is to be built at Salina. Mr. Herrington of that city can give particulars.

The Eureka Street-Railway & Bridge Company, of Dodge City, has been incorporated by H. L. Sitler and others. Capital stock, \$25,000.

## MAINE.

The Portland Railway Company has petitioned the Mayor and City Council for a fifty years' renewal of the location of the route, and the case will be given a hearing on September 6th.

## MASSACHUSETTS.

Boston will have a new street-railway for close connection between the West End and Brookline; it will be owned by the West End Street-Railway Company.

The Meigs elevated one-rail line at Charlestown was given a test by the Board of Railway Commissioners, August 6th. Full-sized cars were run to and fro over the 1,800 feet of track, containing sharp curves and steep grades. The test was said to be quite successful.

The two principal street-railway companies in Boston, the Highland and the Middlesex, are to be incorporated as the Boston Consolidated Street-Railway Company. The capital will be \$1,700,000.

At Lawrence a company has been organized to make electric engines to propel street-cars, under the patent of C. A. Jackson, of Haverhill. The capital stock is set at \$1,000,000, and the company purposes to build its own shops.

The Citizens' Street-Railway Company, of Worcester, has opened its line from Franklin Square to South Worcester.

The Lowell & Dracut Street-Railway Company, capital stock \$15,000, has been incorporated by Percy Parker and others.

## MINNESOTA.

The Minneapolis Council's committee on railways has refused to grant a right-of-way for a street-railroad on Nicollet avenue, owing to the petitions of merchants, frontagers and persons using the street for driving.

The Baldwin Locomotive Works (Philadelphia) are making some soda motors which are to be used on the street-railways of Minneapolis.

## MISSISSIPPI.

The Vicksburg Street-Railway Company contemplates running its cars by electricity.

## MISSOURI.

At St. Louis a movement is on foot to unite all the street-railway companies in one general management, with a trust board composed of officials from the various companies.

A contract has been signed by street-railway companies and the owners of the "Terry" grip patents. It provides for an early test of the grip on an experimental track to be furnished by the companies, and for the sale of the rights to the city at a low cost. All the principal com-

panies have entered into the contract, and if the test proves satisfactory, the system will be rapidly introduced on all the lines.

The Independence & Park Suburban Railroad Company has been granted the right-of-way on Independence avenue between Kansas City and Independence. The engineer is Mr. Knight, of Kansas City. It was originally proposed to use electricity, but it is now probable that steam motors will be employed.

At Kansas City the Metropolitan Street-Railway Company has been incorporated with a capital stock of \$1,250,000, for the purpose of building and operating horse and cable railways in that and neighboring cities.

## NEW JERSEY.

The Orange Cross-Town & Orange Valley Horse-Railway Company has received its franchise. The directors are: Francis M. Eppley, president; J. E. Browne, H. W. Pope, Peter A. Embury and others. Work will soon be commenced.

## NEW YORK.

The Flushing & College Point Street-Railway Company, Brooklyn, has been incorporated by Henry Clement and others, with a capital stock of \$60,000.

At Syracuse the Burnet Street-Car Company, capital stock \$12,000, has been incorporated by Le Grand Sherwood and others.

## OHIO.

The Lima Street-Railway Motor and Power Company has been incorporated by B. C. Faurant and others. Capital stock \$50,000.

## PENNSYLVANIA.

At Philadelphia, recently, the Union Electric Company gave an experimental test of their system on Ridge avenue. The track is similar to that for the cable system, the electric wires being laid in a conduit and connected by a "traveler" and wire with the motor on the car, through the slot. A speed of eight miles per hour was obtained and the motion was easy. The electrician is Mr. William M. Schlessinger.

The Pittsburgh, Knoxville & St. Clair Street-Railway Company will build an electric line from South Thirteenth street, Pittsburgh, to Mount Oliver, via Allentown and Knoxville; a length, of two miles with grades up to 14 per cent. Thomas Evans is president; Henry Stamm, treasurer, and J. W. Patterson, secretary.

## TENNESSEE.

The Chattanooga Belt Railway is to be extended to Ridgedale and other suburban points.

## VIRGINIA.

A street-railway company has recently been chartered at Danville.

## WISCONSIN.

A successful trial has been made of the Appleton electric street-railway.

The franchise, track and plant of the Eau Claire Street-Railway Company have been transferred to Albion G. Bradstreet, of New York (Bradstreet & Curtis bankers), representing a new company, for \$36,000. The road is said not to have been very profitable, and the fare has recently been reduced from seven to five cents. The new company will institute many improvements.

## Manufactures.

### THE ROGERS LOCOMOTIVE AND MACHINE WORKS.

(Continued from page 159.)

#### CHAPTER IV.

#### HISTORY OF LOCOMOTIVE BUILDING AT THE ROGERS LOCOMOTIVE AND MACHINE WORKS.

Soon after he commenced building locomotives Mr. Rogers became convinced that inside-connected engines, with crank-axes, were inferior in many respects to outside-connected ones, besides being more expensive to build and to keep in repair; he also became satisfied that in the matter of steadiness, the inside-connected had no advantage over the outside-connected engine, and that, with proper counterbalancing, the latter could be run as fast as required without any injurious oscillation; and also, that it required more skill to properly counterbalance inside-connected engines than outside ones. Therefore, he was an earnest advocate of this style of engine, and

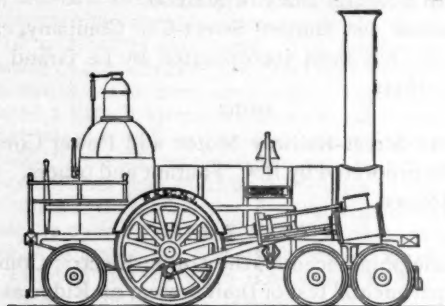


Fig. 15.

recommended outside connected-engines as better than inside-connected ones.

Fig. 15 represents the "Stockbridge," built in 1842, with outside cylinders. In this engine the driving-axle was placed in front of the fire-box and a pair of trailing-wheels behind to carry the overhanging weight. The load on the driving-wheels was, of course, reduced by an amount

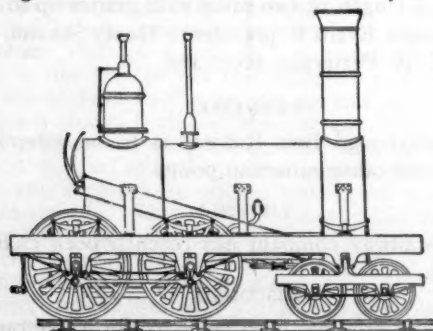


Fig. 16.

equal to that carried by the trailing-wheels, so that this type of engine was also deficient in adhesion and power.

The next step which was made was to substitute a pair of driving-wheels for the trailing-wheels, and couple them with the main driving-wheels. This form of engine, shown by Fig. 16, was patented in 1836 by Henry R. Campbell, of Philadelphia, and was adopted by Mr.

Rogers in 1844. This plan has since been so generally adopted in this country that it is now known as the "American" type. Fig. 17 represents an engine of this kind built at the Rogers Works in 1844. It had four coupled driving-wheels and outside cylinders, the eccentrics were on the back axle, the pumps were full stroke,

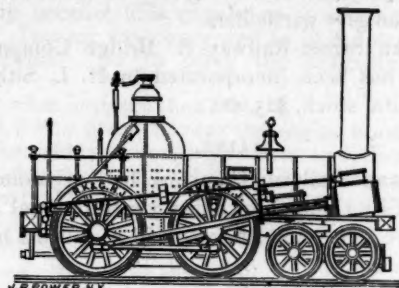


Fig. 17.

worked from the cross-heads. It had springs over the back axle bearings, and also in the centre of the levers which extended from the driving-axle to the centre of the truck on each side of the engine. The truck was pivoted and turned upon a centre pin fixed to the boiler; the arrangement did not give satisfaction, and was altered after a short trial. This engine was remarkable from the

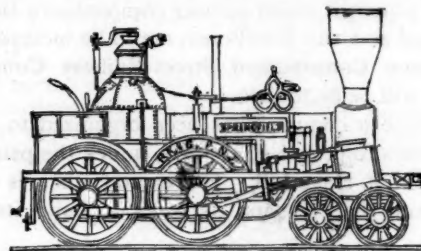


Fig. 18.

fact that it is the first example of the use of an equalizing-beam between the driving-wheels and truck.

The engine shown by Fig. 18 was built in 1845, and had equalizing-levers between the driving-wheel springs; the truck had side bearings and springs over the sides of truck; the pumps had short stroke and were worked from the cross-head, as shown.

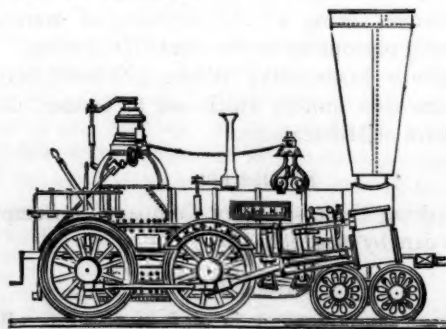


Fig. 19.

Fig. 19 shows an engine built in 1846 with the driving-wheels spread well apart. It had V hooks and independent cut-off on the back of the main valves; this was a favorite kind of engine for many years.

In 1884, Mr. Rogers was requested to furnish some engines with six-coupled wheels for the Savanilla Railroad in Cuba. He then designed and built the first ten-wheeled

engines ever made at the Rogers Works. There is no drawing of these engines extant. They had, however, outside cylinders  $15\frac{1}{2}$  inches diameter by 20 inches stroke. The ten-wheeled engines which had been built previous to this time had inside cylinders and crank axles. The connecting rods of the engines for the Savanilla Railroad

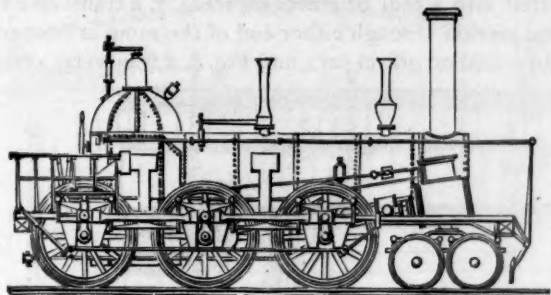


Fig. 20.

were made to take hold of the outside journal of the main crank-pin, which at that time was a new departure.

Fig. 20 represents a plan of ten-wheeled engine, with half-crank keyed on the driving-wheel, same as Baldwin's plan. This pattern of engine was built in 1848 after those for the Savanilla Railroad. The engine had outside bear-

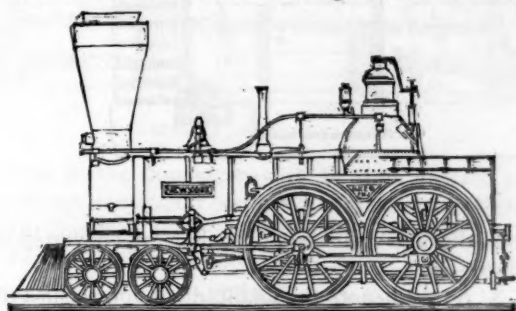


Fig. 21.

ings and equalizing-levers between the springs; it also had cranks on the axles outside the frames to which the coupling-rods were attached. A number of engines on this plan, with cylinders  $17 \times 22$ , were built for the New York & Erie Railroad. They all had independent cut-off valves.

On the style of engine shown by Fig. 22, the shifting-link motion was introduced. Thomas Rogers was one of its earliest advocates, and did more towards its successful introduction on American locomotives than any other person. He was not only an early, but an earnest advo-

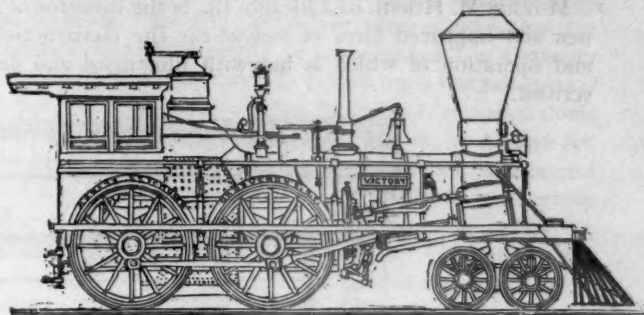


Fig. 22.

cate of it, at a time when it was condemned by some of the most prominent engineers in the country. Time has amply proved all that he claimed for it, which was, that it is the most simple and efficient form of valve-gear that has ever been devised.

Fig. 23 represents a style of passenger engine which was

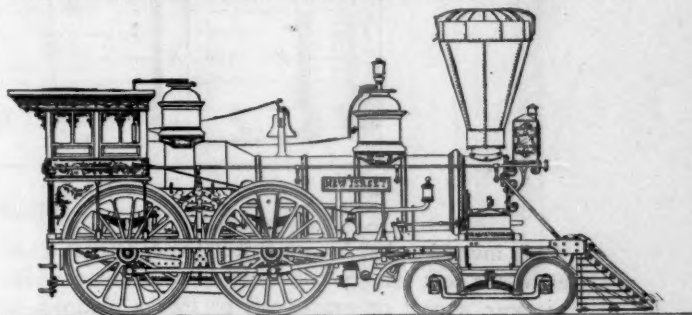


Fig. 23.

first built in 1852. It had  $15 \times 22$  inch cylinder, driving-wheels 5 feet in diameter. It had what may be called supplementary outside frames, which carried the running-board, cab, etc. It had shifting links, hung from below, and the truck axles had both inside and outside bearings.

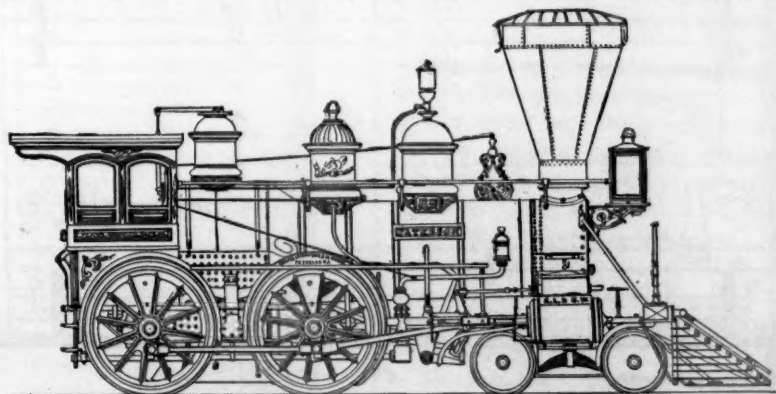


Fig. 24.

Fig. 21 represents an inside-cylinder engine with full crank; the steam-chests were inclined sidewise, so that the valves could be readily got at. This was one of the improvements introduced by Thomas Rogers. The engine had V hooks and independent cut-off valves, and was built for the Paterson & Hudson River Railroad.

The form of engine represented by Fig. 24 was first built in 1853, and was for a long time very popular. The cylinders were  $16 \times 22$  inches, and the driving-wheels 5 feet diameter, although the size of the latter was varied somewhat in different engines.

(To be continued.)

## New Inventions.

### Hirsh's Freight-Car.

MORRIS M. HIRSH, of Chicago, Ill., is the inventor of a new and improved form of freight-car, the construction and operation of which is herewith illustrated and described.

tion through the center of the same; Fig. 3, a transverse vertical section through either end of such car; Fig. 4, a transverse vertical section through the center of the same; Fig. 5, a transverse vertical section through either end of the car as converted into a cattle-car; Fig. 6, a longitudinal vertical section through the center of such car as converted into a coal or gravel-car; Fig. 7, a transverse vertical section through either end of the same as converted into a coal or gravel car; and Fig. 8, a transverse vertical

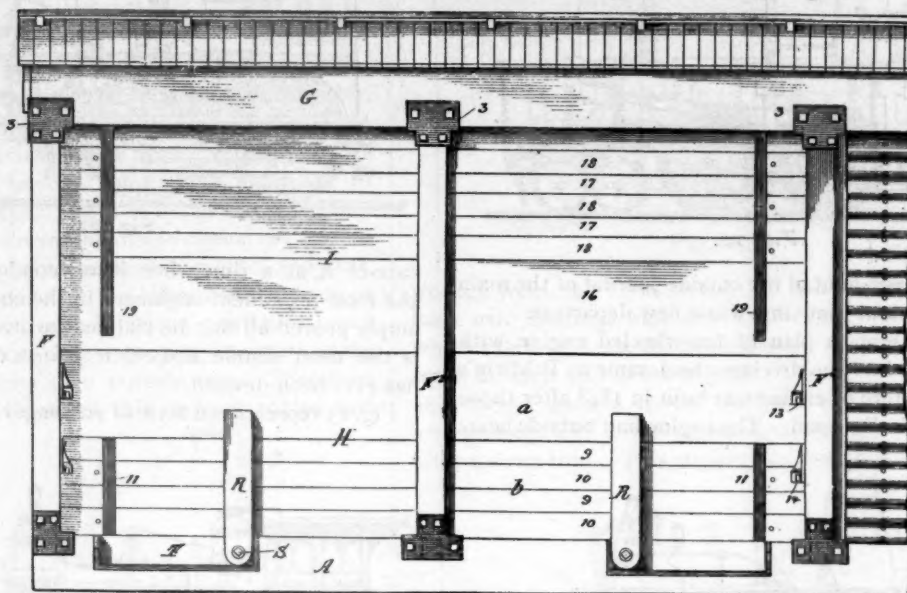


Fig. 1.

### HIRSH'S FREIGHT-CAR.

This invention has for its object the construction of a freight-car that can be converted from a box-car into a cattle-car, a coal or gravel-car, or into a platform-car;

section through either end of such car as converted into a platform-car.

A A' A<sup>2</sup> A<sup>3</sup> denote the longitudinal floor-beams of the

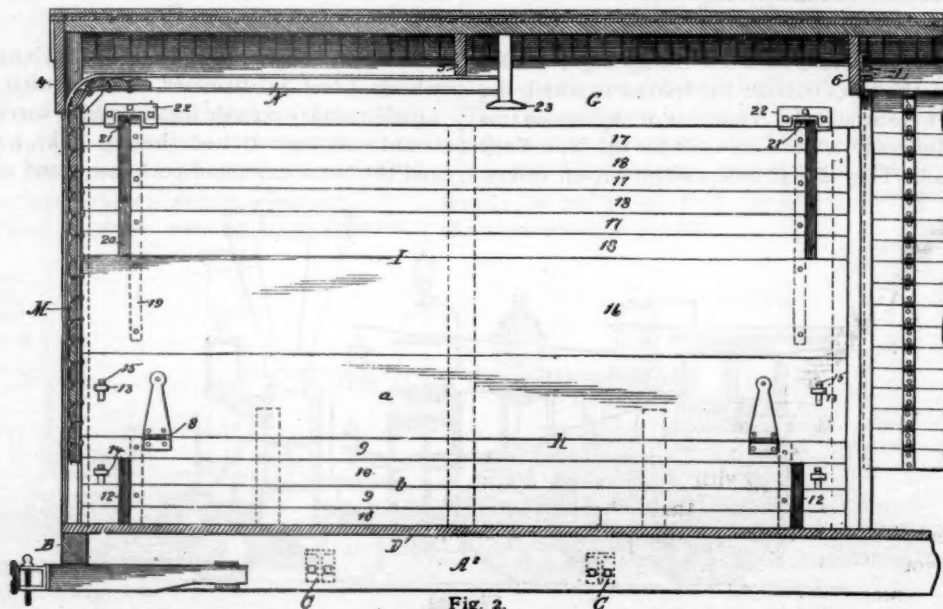


Fig. 2.

### HIRSCH'S FREIGHT-CAR.

and it consists of the novel devices and combinations of devices hereinafter described.

In the accompanying cuts, Fig. 1 represents a side elevation of the box-car; Fig. 2, a longitudinal vertical sec-

tion through the center of the same; Fig. 3, a transverse vertical section through either end of such car; Fig. 4, a transverse vertical section through the center of the same; Fig. 5, a transverse vertical section through either end of the car as converted into a cattle-car; Fig. 6, a longitudinal vertical section through the center of such car as converted into a coal or gravel-car; Fig. 7, a transverse vertical section through either end of the same as converted into a coal or gravel car; and Fig. 8, a transverse vertical

secured a floor D, which covers the space between such beams, and the spaces between A A' and A<sup>2</sup> A<sup>3</sup>, are covered by trap-doors E E', which by hinges are pivotally connected to the rigid floor D, in manner that such doors will form a continuation of such floor D. F are the cor-

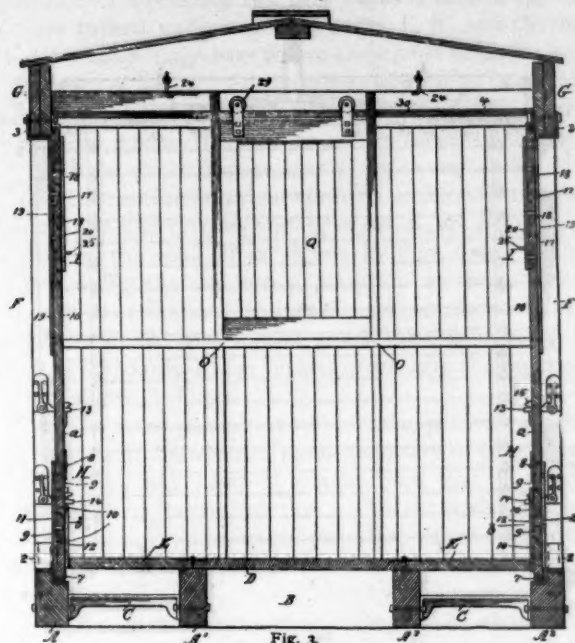


Fig. 3.  
HIRSH'S FREIGHT-CAR.

ner-posts, F' the door-posts, and F<sup>2</sup> intermediate posts tenoned into iron-socket castings 2, that are rigidly secured upon the longitudinal beams A A<sup>3</sup>, and upon these posts F F' F<sup>2</sup>, are secured by suitable castings 3, the longitudi-

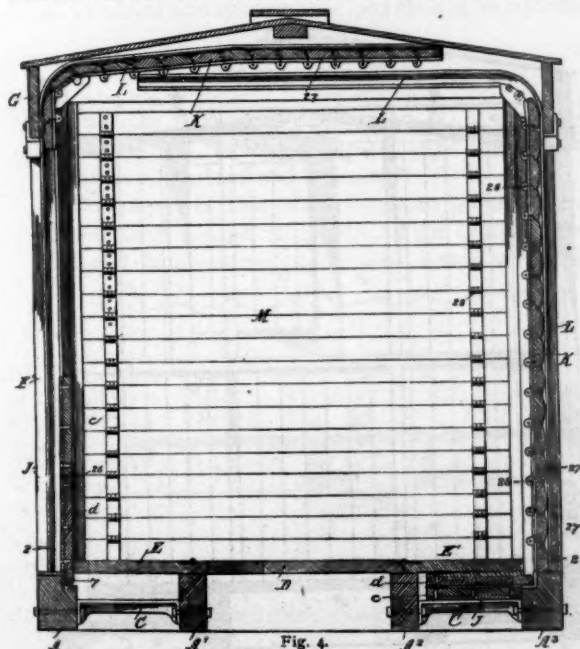


Fig. 4.  
HIRSH'S FREIGHT-CAR.

nal beams G, framed together by end beams 4, and by intermediate roof-plates 5 and 6.

The roof for this car may be constructed in any well-known manner, and the sides between the corner-posts F, and door-posts F', are closed, each such opening by a

lower section H, and an upper section I, such sections forming a tight joint at their meeting line. The section H, is pivotally secured by hinges 7, to form a tight joint with the rabbeted inward upper edge of the floor-beams A or A<sup>3</sup>. Each section H, is again divided longitudinally on its center line into two sub-sections *a* and *b*, that are pivotally secured together by strap-hinges 8, in a manner that the sub-section *a*, can be folded upon the sub-section *b*, and that both sections thus folded can be turned down into the spaces between beams A and A', or A<sup>2</sup> and A<sup>3</sup>, to rest upon iron braces C, and when down to be covered and concealed by trap-doors E E'. The lower sub-section *b*, is composed of longitudinal bars 9 9, and 10 and 10, that form rabbet-joints with each other. The bars 9 9, are secured to exterior upright bars 11, and the intermediate bars 10 10, which close the interstices between bars 9 9, are secured to interior upright bars 12, each two such bars 11 and 12, being pivotally connected to one of the socket-castings 2, by a single hinge 1, that forms part of such

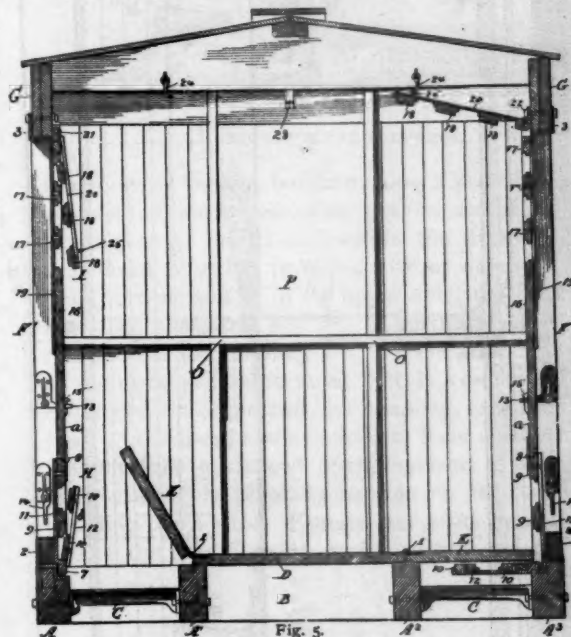
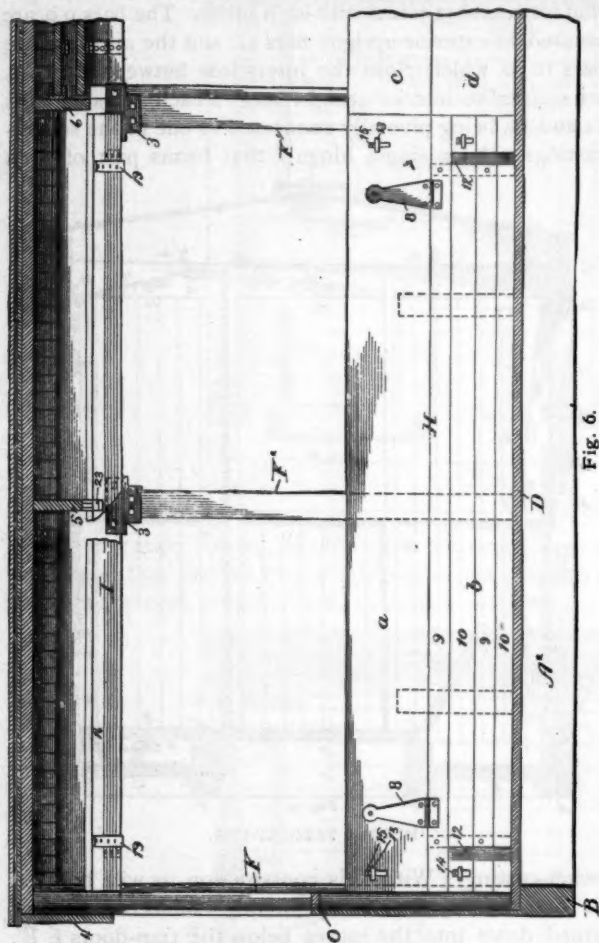


Fig. 5.  
HIRSH'S FREIGHT-CAR.

socket-casting. With this construction, as will be seen the bars 10 10, thus independently connected, can be turned down into the spaces below the trap-doors E E', thereby providing openings between the bars 9, for ventilation and light, which will be desirable for transporting cattle or other live-stock. To posts F F', are secured plates that have pivoted latches 13 and 14, which latches pass through holes in sub-section *a*, and in one of the bars 10, for rigidly fastening such parts on their upright position by keys 15, passed through slots in the ends of such latches.

The sections I, forming the upper half of the side walls of the car-body, are composed each of a solid part 16, and of bars 17 and 18, that form rabbeted joints with each other. The solid part 16, and the bars 17, are rigidly secured to vertical bars 19, and the bars 18, which close the interstices between bars 17, are secured to vertical bars 20, and each two such bars 19 and 20, are suspended by a single hinge 21, formed to a casting 22, secured to beam G. With this arrangement each entire section I,

can be swung under the roof of the car, to be securely held on its upturned position by a turn-buckle or other fastening 23, and when using such car for transporting cattle the bars 18, with their connecting-bars 20, can be swung up alone for ventilating and lighting purposes, and suspended to the roof of the car by hooks 24, engaging with eyes 25, of bars 20. The lower portion of the openings between door-posts  $F'$ , are arranged to be closed for grain, coal or gravel transportation by doors  $J$ , each composed of two sections  $c$  and  $d$ , connected by strap-hinges 26, and the section  $d$ , again being pivotally coupled to post-sockets 2, by hinges 7, all in the same manner as described for section  $H$ , to fold such doors into the spaces



HIRSH'S FREIGHT-CAR.

between the floor-beams  $A A'$ , or  $A^2 A^2$ , where they are covered by trap-doors  $E E'$ , when not required.

For closing the entire openings between posts  $F'$ , doors  $K$ , are provided, composed of slats 27, secured together by hinges 28. These slats move between channel-iron guide-grooves  $L$ , that are secured against the posts  $F$ , and are curved at the top end of these posts, to be continued under the roof of the car on a horizontal line, where these channel-bars are secured to roof-plates 6, and for the two opposite doors, when both opened to clear each other, their guide-bars are placed on different elevations against such roof-plates. The ends of the car are provided with doors  $M$ , constructed like doors  $K$ , and guided between channel-bars  $N$ , which are secured against the corner-posts, to be continued on a horizontal line, where such

channel-bars are fastened against the inward faces of longitudinal beams  $G$ , all as shown by Figs. 2, 4 and 7. Instead of using doors  $M$ , the end of the cars can also be closed by a frame-work  $O$ , that divides such end area into panels which are closed by planking, and in one of the

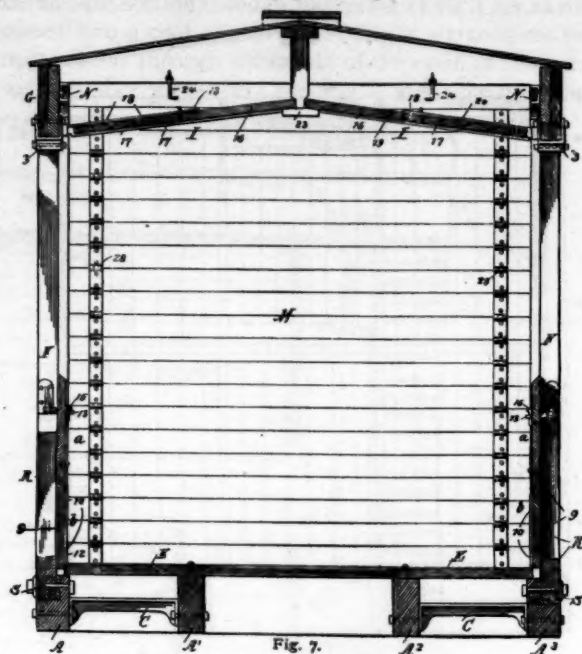


Fig. 7.

HIRSH'S FREIGHT-CAR.

panels  $P$ , is left an opening to be closed by a sliding door or shutter  $Q$ , suspended on rollers 29, that ride upon a bar 30, all as shown in Figs. 3, 5 and 8. For better sustaining the sections  $H$ , of the side walls of the car, particularly

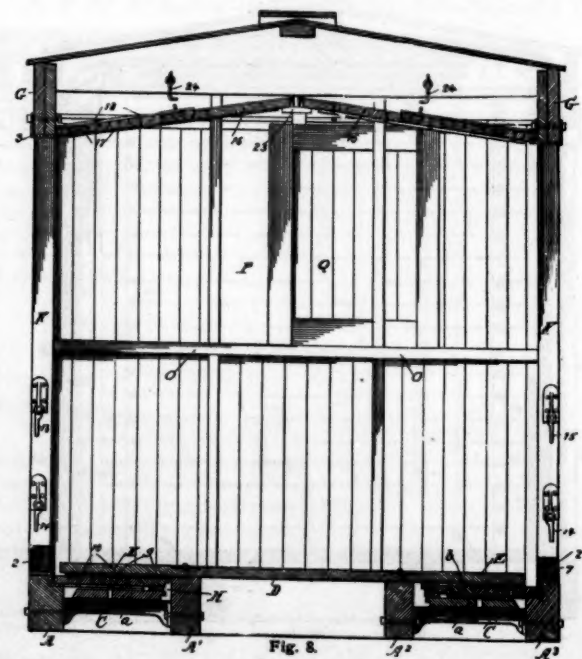


Fig. 8.

HIRSH'S FREIGHT-CAR.

when such car is used for carrying coal or gravel, standards  $R$ , are provided, placed intermediate of posts  $F F'$ , such standards  $R$ , being pivotally secured by bolts  $S$ , into exterior notches  $T$ , of beams  $A A^2$ , in a manner that

when such car is converted into a platform-car such standards can be turned into such notches T.

As shown by Figs. 1, 2 3 and 4, the car is completely closed from all sides and ends, the same as a box-car; but when desired to be used as a car for transporting cattle or other live-stock the bars 10, with their hinge-bars 12, are turned under the trap-doors E E', and the bars 18, with their hinge-bars 20, are suspended to hooks 24, all as shown in Fig. 5. For changing the car to be suitable for the transportation of coal or gravel, or other material of a like nature, the bars 10, are replaced to their upright position, the entire sections I, are swung under the roof, and are secured on their elevated position by turn-buckles 23, and the vertical sliding doors K, are shifted up to be under the roof, all as shown by Figs. 6 and 7; and for changing the car into a platform-car the sub-sections *a* and *b*, of sections I, and the sub-sections *c* *d*, of doors J, are folded and turned under the trap-doors E E', and the standards R, are turned down into the notches T, all as shown in Fig. 8.

The above devices, it will be seen, produce a freight-car that contains all the parts necessary to be adaptable for carrying any kind of freight, and that is strong and durable in its construction. This car is also well adapted for a railway-inspection car, since either side or end can be opened for the officers to examine the condition of the tracks.

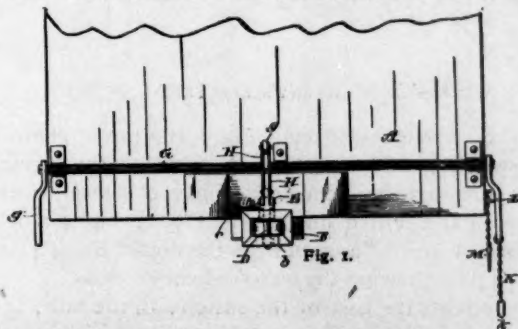
The special merits appertaining to the above-described invention lie in the various uses to which this form of car can be put; with the readiness and ease of alteration to adapt it to the desired purpose, and consequent economy in expense.

The device is under the control of the patentee, Morris M. Hirsh, No. 2585 Archer avenue, Chicago, Ill., to whom all inquiries and communications should be addressed.

#### Wooley's Car-Coupling.

CHARLES D. WOOLEY, of Walden, N. Y., is the inventor of a new and improved form of car-coupling, which is herewith illustrated and described.

The object of this invention is to provide a coupling which shall consist, essentially, of an ordinary link and pin, and hence admit of the substitution of the latter in



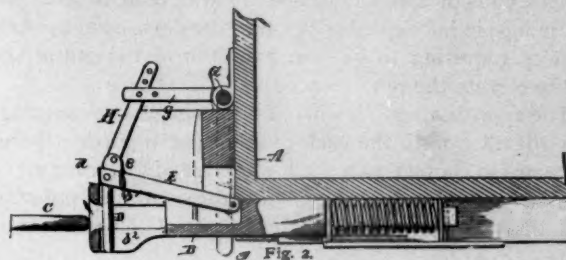
WOOLEY'S CAR-COUPLING.

case of accident or in coupling cars of other roads thereto. A further object is to provide a coupling which shall be automatic in its action, and which will admit of the entering-link being guided by the operator without danger to himself; and also to provide a coupling which may be locked in coupled adjustment against any accidental or

intentional displacement, except by breaking or the consent of the operator.

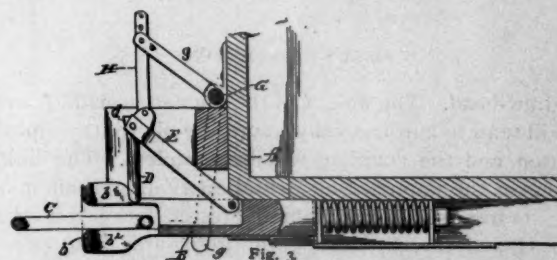
In the accompanying drawings, Fig. 1 is a view of one end of a car provided with the coupling; Fig. 2 is a longitudinal vertical section through the draw-head and approaching link; Fig. 3 represents the position of the pin after it has been tilted by the approaching link and is about to be raised, and Fig. 4 shows the link in a position to be operated upon by the guide-arm.

A represents the end of a car, to which the draw-head B, is secured in any well-known or approved manner. The draw-head B, is provided with a bell-mouth, as is usual, the under lip *b*, being rounded or beveled to admit of the link C, hanging down in an oblique position when



WOOLEY'S CAR-COUPLING.

left to itself therein, but furnishing a bearing which will act as a fulcrum for elevating the free end of the link by bearing down on its end within the draw-head. The draw-head is further provided with an extended longitudinal vertical slot *b'*, in its upper side, and with a corresponding elongated slot *b''*, in its lower side for the reception of the coupling-pin D. The coupling-pin D, is of the same general form as that in common use in the ordinary form of pin-and-link coupling, excepting that its head *d*, is reduced and extended to form points of attachment for the guide and operating-arms E and F. The guide-arm E, is pivotally secured to the head of the coupling-pin a short distance below its upper end, the end of the arm E, being preferably bifurcated, as shown



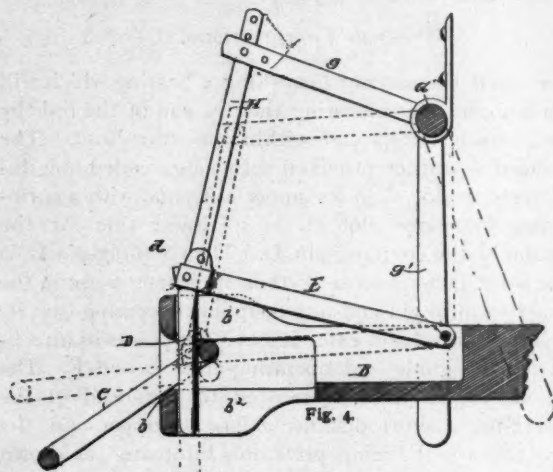
WOOLEY'S CAR-COUPLING.

at *e*, to receive the head of the pin between its branches. The opposite end of the arm E, is pivotally secured to the draw-head at a distance from back its mouth. The back of the squared portion of the pin D, is so arranged as to engage and come in contact with the lower edge of the rear wall of the jaw formed by the bifurcated end of the arm E, when the lower end of the pin has been tilted back from the mouth of the draw-head sufficiently to allow the end of the link to force it upwardly by horizontal pressure.

An operating-shaft G, is journaled in suitable bearings across the end of the car, and provided with an operating-

arm *g*, which extends over the draw-head, its free end being about over the position which the pin would naturally occupy when in coupled adjustment. The free end of the arm *g*, is connected with the upper end of the pin by a link or other suitable connection *H*. The ends of the operating-shaft *G*, are provided with handle-arms *g'*, for rocking the shaft *G*, from either side of the car. The end of one of the arms *g'*, is provided with a chain *K*, having a link or eye *k*, adapted to be placed over a staple *L*, in the side of the car, and a pin or padlock *M*, is adapted to secure the chain to the staple, and hence prevent the movement of the arm *g'*, and operating-shaft *G*. The coupling-link *C*, is of the ordinary elongated form in common use. The parts are so arranged that the arms *g'*, on the ends of the operating-shaft will tend to hold the coupling-pin in coupled position in the draw-head by their gravity, requiring to be swung away from the end of the car to elevate the pin or uncouple.

The approaching link when it first engages the coupling-pin will tilt it until the back of the squared portion thereof comes in contact with the lower edge of the rear wall of the jaw, as before described, when the continued pressure will lift the pin and allow the link to slide beyond it in



WOOLEY'S CAR-COUPLING.

the draw-head. The weight of the pin and arms *E*, *g* and *g'*, will tend to automatically return the pin to its coupled position, and the coupling will be complete. The link, resting in the approaching or stationary draw-head, may have its free end elevated or depressed by rocking the shaft *G*, and thereby causing the guide-arm *E*, to press heavily or lightly on the end of the link within the draw-head. This manipulation of the link from the side of the car or out of the way of danger is an important advantage, while a chain may be connected to the end of the connecting-bar *H*, and carried thence to a staple at the edge of the car-roof, thus allowing uncoupling from that position.

The form of coupling shown and described may be applied to either freight or passenger-cars, but is well adapted to use on freight-cars. In case of accident or possible derangement, an ordinary link and pin can be substituted without delay, and a stray car on any other road could be coupled with any other car where the ordinary link and pin are used.

It is evident that the means for operating the pin might be somewhat varied in form and arrangement to suit different forms of cars without departing from the spirit and scope of the invention; hence it is not limited strictly to the construction herein set forth.

It is claimed for this form of car-coupling that it is equally well adapted to application to different forms and styles of cars; and will work with perfect ease either on grades or curves.

The device is under the control of the inventor, to whom all inquiries and communications should be addressed.

#### Waters' and Sweeney's Electrical Switch.

EDWARD G. WATERS and ROBERT G. SWEENEY, of Terre Haute, Ind., are the inventors of a new and improved electrical switch, the construction and operation of which is herewith illustrated and described.

The object of this invention is to produce a switch by which any one of several telegraph or other lines may be connected with a single instrument at pleasure. This object is accomplished by connecting the several lines to a series of contact-springs which are arranged radially to a central hub carrying two points which are electrically connected with the two binding-posts of the instrument, each wire of the several lines being connected to one of said contact-springs, and the contact-springs connected to the incoming wires of each circuit being arranged to come in contact with a part or strip connected with the outgoing line-wire when not separated therefrom by the contact points on the revolving hub.

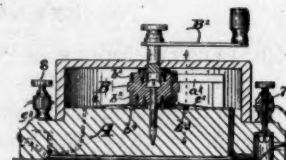
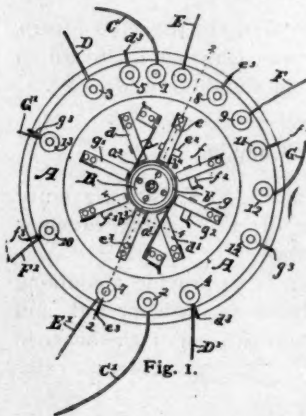


Fig. 2.

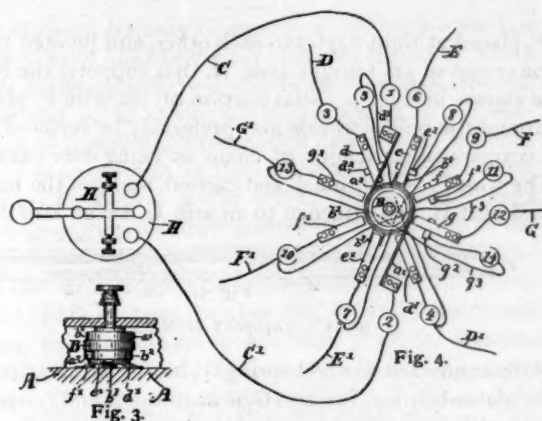
WATERS' AND SWEENEY'S ELECTRICAL SWITCH.

In the accompanying cuts, Fig. 1 is a top or plan view of a switch embodying the said invention, the casing or cover portion being removed; Fig. 2, a central vertical section on the dotted line 2 2 in Fig. 1; Fig. 3, a detail elevation of the hub as seen from the dotted line 4 4; and Fig. 4, a plan showing the electrical connections.

A represents the base of the switch; B, the hub; C C', the incoming and outgoing instrument wires, respectively; D D' E E' F F' G G', the incoming and outgoing wires of several electrical circuits or main lines, and H, the electrical instrument. The base A, is formed of wood or some other non-conducting material, and carries the hub, contact-springs, binding-posts and contact-strips, as shown. The hub B, is centrally mounted on the base, and revolves thereon, a crank B', being provided as a means of turning

it. Its body is formed of non-electrical material, and it carries two rings  $b' b^2$ , one of which is connected to one of the instrument wires and the other to the other by contact-springs  $a' a^2$ . These rings are also connected to the contact-points  $b^3 b^4$ , and may, by means of said contact-points, be also connected with either of the line-wires, as will be hereinafter more particularly described.

The operation of the device may be described as follows: Supposing that the operator desires to use the line  $E E'$ , he will first turn the hub  $B$ , until the contact-points  $b^3 b^4$ , have passed underneath and are in contact with the contact-springs  $e e'$ , which form terminals for said wires, which at the same time raises the contact-spring  $e$ , away from the strip  $e^2$ , and breaks the independent circuit outside of the instrument. The course of the current is then in from the line-wire  $E$ , through its binding-post 6, to the contact-spring  $e$ , thence, by the contact-point  $b^4$ , the ring  $b^2$ , and the contact-spring  $a^2$ , through the binding-post 1, to the wire  $C$ , over the wire through the electrical in-



WATERS' AND SWEENEY'S ELECTRICAL SWITCH.

strument  $H$ , and back over the wire  $C'$ , to the binding-post 2; thence to the contact-spring  $a'$ , to the ring  $b'$ , and to the contact-point  $b^3$ ; thence, by the contact-spring  $e'$ , to the binding-post 7, and out over the outgoing line-wire  $E'$ . Meantime each of the other electrical circuits or main lines are uninterrupted, and the course of the current is as follows: A current comes in over the main line  $D$ , to the binding-post 3; thence to the contact-spring  $d$ , to the contact-strip  $d^2$ ; thence to the binding-post 5; thence across underneath the switch, by the loop  $d^3$ , to the binding-post 4, and out over the wire  $D'$ . A current comes in similarly over the wire  $F$ , to the binding-post 9; thence to the contact-spring  $f$ , to the contact-strip  $f^2$ ; thence to the binding-post 11; thence across underneath the switch by the loop  $f^3$ , to the binding-post 10, and out over the wire  $F'$ . A current comes in similarly over the wire  $G$ , to the binding-post 12; thence to the contact-spring  $g$ , to the contact-strip  $g^2$ ; thence to the binding-post 14; thence across underneath the switch by the loop  $g^3$ , to the binding-post 13, and out over the wire  $G'$ .

When the operator desires to use another line, the hub is turned to bring the contact-points  $b^3 b^4$ , into contact with the contact-springs of the line desired, and the current then passes over the line  $E E'$ , similarly to the course above described, bringing the binding-post 8, and loop  $e^3$ , into service, as will be readily understood. It will also be

readily seen that the contact-springs  $d' g'$  and  $f'$ , will perform similar service, when their respective main lines are brought into use, to that described in connection with the description of the course of the current over the line  $E E'$ , as performed by the contact-spring  $e'$ . It will be understood, of course, where contact-springs, contact-strips, and contact-points are referred to, that these may be any ordinary means of contact which will accomplish the result; springs, points and strips being shown and described merely as the preferable or more convenient construction. In order to cut out the instrument from all the circuits, it is only necessary to so turn the hub that the contact-points will be between some of the several contact-springs, without touching either, when all of the circuits will be similar to that just described.

As will be readily seen, by the use of this invention a single telegraphic or other electrical instrument may at will be put in circuit with either one of any number of lines, and thus the expense of separate instruments for each line can be saved, as well as the room which they would occupy if used, thus making the invention especially valuable for such places as a superintendent's office of a railroad, which officer usually desires to have a telegraphic instrument on his desk, with which he can communicate with either of several officers or places at pleasure, but which it has not been practicable to do where the complete telegraphic outfit was used with each line. When this device is employed, a relay can be used with each of the several lines which will permit calls to be heard, while the key and sounder only need be placed on the desk of the operator.

It is claimed for this invention that it is simple in its operation and application, and durable in construction; while its multiplex character renders it a most useful and economical addition to telegraphic systems. All inquiries and communications appertaining to the patent should be addressed to Edward G. Waters, No. 613 Mulberry street, Terre Haute, Ind.

#### Mott's Railway-Signal.

ELIAS HICKS MOTT, of Sangerfield, N. Y., is the inventor of a new and improved form of railway-signal, which is herewith illustrated and described.

This invention relates to improvements in signals for use on railway tracks at crossings and the like; and the novelty consists of the peculiar construction and combination of parts, substantially as hereinafter fully set forth.

The primary object of this device is to provide an improved signal which is automatically operated by a passing train to give an audible alarm for the purpose of warning persons and teams of the approach of the train. A further object of the invention is to provide mechanism which shall be ready for action at all times; which shall not be liable to become broken by the car-wheels; which shall be simple, strong, and durable in construction, thoroughly effective in operation and comparatively cheap.

In the accompanying cuts, Fig. 1 is a view in side elevation showing the improved apparatus applied to a rail of a track; Fig. 2 is a vertical cross-sectional view through the track-rail on the line  $x x$  of Fig. 1; Fig. 3 is an enlarged view, in detail, of audible-alarm device; and Fig.

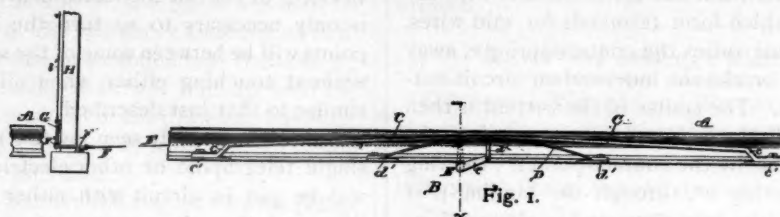
4 is a detail view of a modification. Figs. 5 and 6 are enlarged detail views.

A designates one of the rails of a railway-track to which the improved automatic signal devices B, are applied at any convenient and desired point—as, for instance, where a road or street intersects and crosses the track. C C designate two longitudinal bars, which are pivotally or loosely connected directly together, or by means of an intermediate (link shown in detail in Fig. 5), and the bars are located parallel with and inside of one of the rails of

shaft is provided with an upright arm  $e'$ , that has an inwardly-extending lug  $e^2$ , located just below the head of the rail, said shaft being journaled in proper bearings suitably held in place.

A transmitting-wire F, is connected to the outer end of the arm  $e^2$ , and this wire extends along beneath and is protected by the head of said rail, and the wire is supported in staples or eyes  $f$ , that are secured in any suitable manner to the rail.

The wire F, leads to and passes around two pulley-wheels



MOTT'S RAILWAY-SIGNAL.

the track, the ends of said bars being bent, as at  $c$ , and provided with slots, through which are passed bolts to loosely connect the bar to suitable supports  $c'$ . The opposite free ends of the side-bars are brought together and lie in a plane just below the upper surface of the head of the rail A, and these meeting ends of the side-bars are loosely connected to a curved spring D, in any suitable manner; or they may be left free of the spring and merely rest thereon. These bars are acted on successively by the car-wheel flanges of a passing train to operate the audible or visible alarm devices.

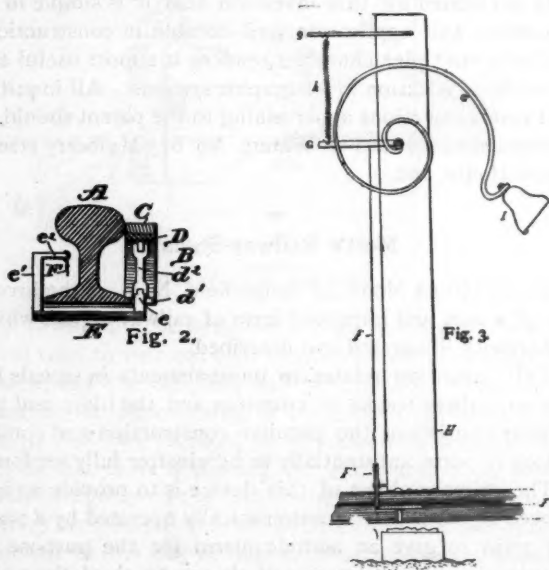
F', placed at right angles to each other, and pivoted to the lower end of an upright post H, that supports the bell I, as shown in Fig. 3. That portion of the wire F, playing around the pulley-wheels may preferably be replaced with a corresponding length of chain as being more flexible. The wire F, is continued, and carried up from the base of said post H, and attached to an arm G, which arm is piv-



MOTT'S RAILWAY-SIGNAL.

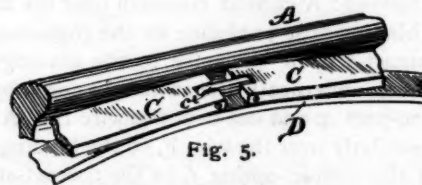
otally connected to a coil spring  $G'$ , having at its extremity the alarm-bell I. The arm G, is at its outer end connected with the upper fixed arm  $g$ , by a spiral retracting-spring  $h$ , having the desired effect of returning the bell apparatus to its normal position after the passing of a train.

It will be seen that when a train passes over a track which has the improved signaling apparatus applied thereto the wheels will depress the bars C, and spring D, thus causing the rock-shaft to oscillate, each wheel of the train successively and rapidly imparting a sharp and sudden



MOTT'S RAILWAY-SIGNAL.

The spring D, is made curved or bow-shaped, and the spring lies below the side-bars, to automatically return the side-bars to their proper position with relation to the rail, so that they will be acted on by the wheels of a passing train. The ends of the spring D, are connected to suitable supports  $d'$ , and at or near its middle the spring has a link  $d^2$ , the free end of which link is pivotally connected to an arm  $e$ , of a rock-shaft E, that extends under the rail of the track. The opposite end of the rock-



MOTT'S RAILWAY-SIGNAL.

tension or pull to the wire F, with the obvious effect of giving a rapid motion to the bell I, thus ringing the alarm. From the nature of the coil-spring  $G'$ , the bell will retain its motion for some period after the passage of the train over the spring D, thus giving the desirable feature of continuing the alarm even after the rail mechanism and the connecting-wire F, have ceased moving.

In the modification shown in Fig. 4 of the drawings it is proposed to dispense with the longitudinal bars C, and employ two or a single spring-bar D, to be acted on by the car-wheel flanges to rock the shaft E, and sound the alarm; but it is preferable to employ the bars C, and

spring D, as it has been found by experiment that the latter devices give better results, are cheaper, and more durable.

It is not necessary to limit the device to the exact construction shown and described, as changes therein may be made without departing from the principle thereof.



Fig. 6.

MOTT'S RAILWAY-SIGNAL.

It is claimed for this invention that it is simple in construction, durable and economical; while it works with absolute certainty, and forms a reliable and perfect railway alarm-signal. The patent is under the control of the inventor, to whom all communications should be addressed.

#### A Colossal Railway Station in North London.

THE Midland Railway Company, which, within the last few years, have absorbed more than one parish in North London in the construction of their metropolitan terminal stations and other works, are now engaged in the construction of a gigantic merchandise depot at St. Pancras, which, it is stated, will be the largest and the most costly railway goods station in the world. Some twenty years since the company obtained possession of a portion of the locality known as Somers Town, for it was on the occasion of their construction of their extension between Bedford and London, about the year 1867, that they purchased the land and buildings upon which their St. Pancras

Station and hotel now stand, and, it is stated, as showing the historical character of the locality, that during the excavations for the station buildings several relics, including coins of the time of Edward II and other reigns, were discovered. About the same time a large portion of Agar Town was also absorbed, and a numerous population swept away, during the erection of the company's Camden Town Station. These works have been followed by the erection of the great undertaking now in progress, for which, in the year 1877, the company obtained an Act of Parliament for the purchase of the land and buildings extending between the company's present station and Ossulston street, in the Euston road, and stretching northwards to Phoenix street, covering an area of between 14 and 15 acres. This purchase included all the proprietary rights of Earl Somers, and involved the demolition of several hundreds of houses and business premises, and the forced exodus of a population estimated at upwards of 4,000. It is worthy of notice that, from antiquarian records and maps of the period still in existence, it appears that about the end of the last century the locality was a suburban pleasure resort, on which stood the ancient Brill Tavern and surrounding taverns, and that the site on which the depot is now being constructed was known as "Caesar's Camp, called the Brill at St. Pancras."—*Railway and Tramway Express*.

THE office of Mr. M. N. Forney, Secretary of the Master Car-Builders' Association, has been removed from No. 73 Broadway to 23 Murray street, New York, to which address communications to him should in future be directed.

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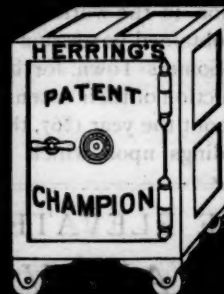
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